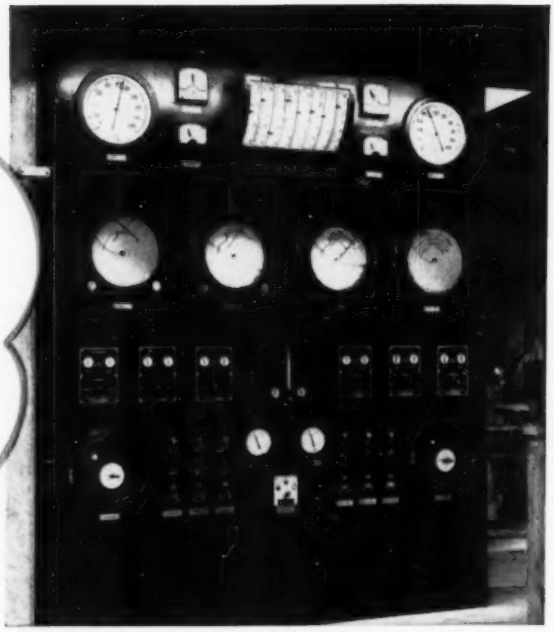
MECHANICAL ENGINEERING

January 191

TIPS ON HOW TO SELECT BOILER CONTROL



Bailey Boiler Control Panel for a 300,000 lb. per hour pulverized coal fired boiler. Both combustion and three-element feed water controls are based on accurate measurements made by meters located on this control panel.

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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 69 NUMBER 1

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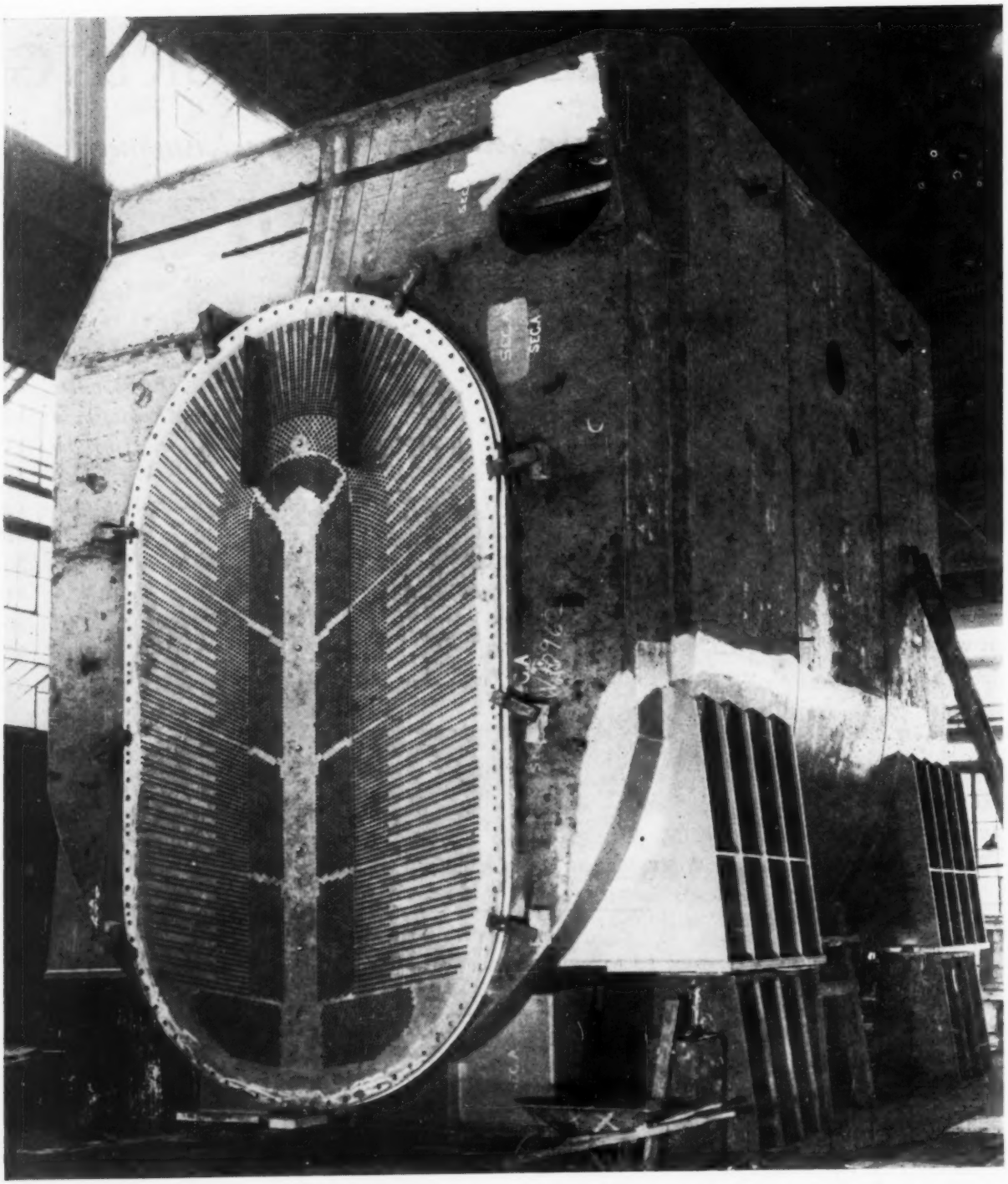


Foster-Wheeler Condenser for Southwark Station of Philadelphia Electric Company

(One of two of the largest cross-flow condensers ever built. Each unit, 35 ft high, 46 1/2 ft long, and 20 ft wide, will condense exhaust steam from a turbine of 150,000-kw rated capacity. Condensing water requirements are 146,000 gpm. Each unit weighs 660,000 lb, empty, and with water, 1,100,000 lb. The tube sheets, the largest bronze plates ever rolled, measure 11 ft, 7 in. × 21 ft, 1 in., and are 1 1/2 in. thick. Each plate weighs approximately 14,000 lb. There are 12,316 tube holes drilled in each plate for the condenser tubes, in addition to 108 bolts. The 86 tons of tubes are 28 ft long each.)

MECHANICAL ENGINEERING

VOLUME 69
No. 1

JANUARY
1947

GEORGE A. STETSON, *Editor*

Division of Atomistics

ABOUT the time the British Colonies in America were battling for their independence, Boulton and Watt in England were developing the steam engine, a source of power on which western civilization, and particularly the United States of America, based an industrial economy and greatly increased the productivity of the worker. About the time The Institution of Mechanical Engineers came into being these same regions were reorganizing their concepts of transportation by means of the railroad and the steamboat. About the time The American Society of Mechanical Engineers was organized electricity was beginning to find acceptance as a means of illumination (and eventually of power), and shortly thereafter, at Niagara Falls, the great decision was taken that electricity would usurp in large measure, except for special applications, mechanical, hydraulic, and pneumatic means of transmitting energy over considerable distances. A few years later engineers were confronted with the automobile and the airplane as potential means of transportation. These and other examples can be cited of developments which faced skepticism, indifference, ridicule, and even hostility but which had incalculable influence in the evolution of modern society.

Today the world is speculating on the influence that atomic power may have on its economy and its way of life. It would be a rash prophet who would, at this moment, place atomic power in the same category as that in which the examples cited fall; but it would be an even rasher man who would fail to admit the possibility of atomic power's being placed in that category by some future appraiser having the benefit of historical perspective.

The article by A. C. Klein in the December issue contained a significant suggestion. He proposed that The American Society of Mechanical Engineers organize, as one of its professional divisions, a "Division of Atomistics." Members of the Society will be glad to know that the Professional Divisions Committee has already acted on this suggestion and is exploring the possibility of setting up such a division.

Although a decade may pass before atomic power will have been developed to a point where it will engage the active attention of any considerable number of power-plant engineers, The American Society of Mechanical Engineers should anticipate this future interest without delay. Events moved slowly in the early days of the steam engine, the railroad, alternating current, the automobile, and the airplane; and the pioneers in these developments were private enterprisers. Today, engineering moves much faster. With nuclear energy, moreover, the government has a majority voice in its development for reasons which everyone knows and which were emphasized by P. W. Swain in his dramatic address at the Fuels Division luncheon during the 1946 A.S.M.E. Annual Meeting when he described what really happened at Bikini.

It would be natural for the government to turn to the engineering societies and the engineering profession for aid in carrying on industrial developments in nuclear-energy application. If it were to do so, neither the A.S.M.E. nor the engineers who make up its membership would wish to find themselves in the position of not being able to give this needed help in abundant measure. It would seem, therefore, that the Society faces an opportunity and an obligation to stimulate widespread interest in nuclear energy and its applications, to build up an authoritative literature for the use of engineers, and to provide means by which engineers may inform themselves on fundamental principles and practical developments in this field.

Members of the Society will recall that the A.S.M.E. already has a Committee on Nuclear Energy Application, with past-president Alex D. Bailey as its chairman, and that this committee has already provided public addresses on this subject. Notable among these are those by Senator Brien McMahon and Admiral H. G. Bowen, delivered at the 1946 Semi-Annual Meeting in Detroit and published in MECHANICAL ENGINEERING, September, 1946, and by A. G. Klein, at the 1946 Fall Meeting in Boston, that appeared in the December issue.

Useful and important as these addresses have been, it will be recognized by the practical man that something more specific is needed—a group of men formed into Mr. Klein's proposed Division of Atomistics, who will lay out a comprehensive and detailed long-range program of papers and activities that will meet the needs of engineers who wish to become proficient in the engineering phases of nuclear-energy application.

The task such a division would face will be gigantic and difficult. Well performed it would pay rich dividends in the prestige of the Society in meeting promptly a great public need and in opportunities for engineers who may plan careers in this new area. Speculation as to what such a division might accomplish is futile except to fire the imagination and quicken the hope that the A.S.M.E. may soon be able to undertake this great project.

A.S.M.E. Papers

OVER a period of more than threescore years great changes have taken place in A.S.M.E. technical papers. There has been an expansion in volume, which is understandable when the increase in membership and broadening of the field of mechanical engineering are considered. There has been a change in pattern of the treatment of technical subjects, which has followed the shift to theoretical analysis. There has been an improvement in the craftsmanship of engineers as authors, although this change is less apparent in the published papers than it is in the manuscripts as originally submitted. And there has also developed a greater interest on the part of the public in matters discussed by engineers, upon which some persons base the contention that further improvements in the presentation of technical subjects should be encouraged.

The foregoing comments are, of course, generalizations to which important exceptions will be noted by persons familiar with A.S.M.E. papers of the past. One may despair, for example, of hoping that there will ever appear in the Society an author who could or would equal Robert Henry Thurston in summarizing the state of the art of mechanical engineering and in assessing its future trends. For Dr. Thurston, during his two terms as the Society's first president, delivered addresses that were models of clear perspective, of accurate appraisal of contemporary events, and of prophetic vision. They were, moreover, written in a lucid literary style with which only the most fastidious could find fault. Nor is it likely that we shall ever see, as an A.S.M.E. paper, so stupendous a piece of work as Taylor's presidential address on the art of cutting metals. The early papers of Gantt and Gilbreth opened a new field of fundamental thinking for engineers and are today looked upon as classics of engineering literature. Other outstanding examples of the best that engineers have had to offer could be cited, but these will suffice to admit the charge of generalization.

As evidence of the change of pattern of A.S.M.E. papers a comparison of the papers of the Society's 1946 Annual Meeting with those of half a century ago can be made. It will be noted that papers relating to the art, as contrasted with the science, of engineering predominated at early meetings. Then there were few papers of the analytical type; and such papers as contained mathematics seldom ventured very far into the less familiar areas of that useful method. In 1946, it will be noted, a considerable portion of the papers presented, notably those contributed by the Applied Mechanics and the Heat Transfer Divisions, represent work in which the engineer in the research laboratory has brought to the analysis and exposition of his findings the precision of statement which the language of mathematics provides.

Although it is an almost universal habit of engineers to deplore the inability of their fellows to express themselves in clear well-written English, it is apparent to anyone who has seen manuscripts submitted over the last quarter century that great improvement has taken place. There can be little doubt that this improvement can be attributed to the greater proportion of engineers today who have been educated in the colleges; that the colleges have stressed the importance of good writing and have trained men to do it; and that the requirements of the research laboratory and of industry have forced engineers to be more careful in the form and quality of their technical papers. In this the engineering societies themselves have probably exerted considerable influence because the body of engineer readers has become more critical in demanding better-written papers.

In spite of the fact that great improvement has been made in the writing of technical papers, there still remains a need to devote more attention to this point. And parallel with it is the need for improvement in the presentation of such papers at engineering-society meetings. Toward improvements in both these fields, the A.S.M.E. is engaged at present in the preparation of a manual for authors which should be ready for publication in the near future.

In the December issue of MECHANICAL ENGINEERING an A.S.M.E. member criticized the writing and presentation of technical papers. The letter has been read with approval by some and with disapproval by others. If an engineer fails to understand a technical paper because of intellectual incapacity or gross ignorance of, or indifference to, the subject matter, no matter how well presented it may be, there is little anyone can do about it. But this is not always the case; many times the author himself is at fault either in his writing or his delivery. In such cases the cure lies with the author, who thus does a disservice to himself, to his employer, and to his fellow engineers. Attention to the fine points of clear simple expression, both in writing and in oral delivery, will vastly enhance the author's reputation as an engineer and the prestige of his employer. It will also vastly aid the purpose for which the paper was written—the benefit to fellow engineers in their own work. It is sad to realize that many times a man who has spent thousands of dollars and months of time on an engineering problem is satisfied to permit the results to be recorded for all time in the literature of engineering in a badly written and perhaps unintelligible paper. Many of the early scientists used to announce their discoveries in cryptograms. The engineer of today aims at writing a technical paper worthy of the time and money that were expended in securing the material on which it was based. "The end crowns all."

Applied Mechanics Reviews

IN co-operation with the American Institute of Physics, the American Mathematical Society, the American Society of Civil Engineers, the Institute of the Aeronautical Sciences, and the Society for Experimental Stress Analysis, The American Society of Mechanical Engineers proposes to establish a new magazine to be known as *Applied Mechanics Reviews*. It will be the aim of the reviews to cover the current literature of applied mechanics of the entire world. The reviews will be in English.

PUBLIC RESPONSIBILITY *of* ENGINEERS

By D. ROBERT YARNALL

PRESIDENT, THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

WHAT is mechanical engineering? Is it a craft or a profession? If a profession, what are the beliefs, objectives, and faith of the individuals who are members of the profession?

This summer, C. E. Davies, secretary A.S.M.E., presented a paper before the International Technical Congress in Paris, on the subject, "Organizations of Engineers in the United States of America." This address was an exceedingly helpful survey of our American experience in organizing engineers who are members of our profession. May I quote from the opening paragraph of this splendid paper:

> The Engineer in the United States of America is a vital factor in the life of his nation. He changes its economy and modifies the customs and social habits of its people. He is an idealist and a dreamer. He is a realist and a doer. He co-operates with his colleagues in technology but is impatient with politics. He is frequently charged with lack of understanding of the social effects of his work. He is modest of his talents and likes to be called to high places rather than aggressively press the crowd for position. This results in some places in an undervaluation of his services. He has the traits common to human beings, as is shown by the organization of his profession, but his work is good and he does have a high sense of professional responsibility.

"Endless Horizons," a recent book by Vannevar Bush, put out by The American Council on Public Affairs, in the chapter entitled "The Qualities of a Profession," says:

> I recognize the distinguished careers of a generation of men who have practiced in the profession to its credit and honor. Though the task be difficult, on account of the nature of many of our relationships to society, nevertheless traditions are being formed, the consciousness of the membership is becoming aroused, and I confidently expect the profession of engineering to develop in a manner of which we can be justifiably proud.
>
> And to those in the ranks who may not have yet seen the light, I would preach the doctrine, without pulling any punches, without mincing any words, that the path of professional attainment lies open before them, that it is a thorny path that is easily lost sight of among the rocks and rubbish, that it can be adhered to only by sacrifice and by support of those who lead the way, that it is a long path which leads down into the valley into which the sun does not shine, but that it leads at last to the heights—to the heights of true professional attainment, where honor and individual recognition by fellows is the real reward, and where the watchword is that old, old theme, which has never lost its power, and which may yet save a sorry world, ***simple ministration to the people.***

WHAT IS THE FAITH OF THE ENGINEER IN HIS PROFESSION BASED UPON?

We are aware that our countrymen are expecting much of engineers these days, because the engineer in the United States is such a vital factor in the life of the nation. Looking at our profession as a whole, as Vannevar Bush has suggested, I have a conviction, based on my experience of recent months, that our "engineering sights" should be elevated. The standards of our profession must be raised, not lowered, if engineers are to meet the challenge of social change and production as well as research and discovery. May we review some of the more basic aspirations from which our actions spring—and may I remind you that each one of you may have his own way of expressing aspirations.

1 We believe in the natural laws governing the universe.

2 We believe in the ability of men to design, construct, and operate machines based on these laws.

3 We believe that men can modify their physical environment for their material benefit.

4 We believe that back-breaking toil can be transferred to machines.

5 The nature of the engineer's training and his work establish his firm faith in truth and integrity.

6 His confidence in the future of our country is very strong.

7 We believe that through education men may attain wisdom and understanding, and may learn to live together in peace.

8 We believe in the power of good will in a world too prone to rely upon force.

9 As citizens in a unique position in our industrial society, the engineer believes in the dignity and intelligence of the individual.

10 Conscious of the dependence of his fellowmen on engineering, he feels responsibility for seeing to it that engineering benefits and does not harm them.

11 We believe in the need for engineers competent in design, production, management, and research, but who are also good citizens, and conscious of human needs.

I like to think that the work of the engineer on the social level is based on mutual trust and fair-dealing. That he recognizes responsibility alike to the workers, to the public, to customers, and to investors. That he desires to use his gifts to help bring about understanding and confidence in these troubled situations. I have the deep conviction that, in spite of crises now upon us and yet to come, the belief and faith of the engineer in all these things is unshaken and that the nation's trust in him as a professional man will not be in vain.

MOTIVATION—THE THING THAT MAKES THE ENGINEER FUNCTION

Are we who have chosen engineering endowed by birth with "good citizenship characteristics?" Alas, far from it. Somewhere along the line with the help of good environment and sound training there must be built in us a sense of concern, a social conscience, that will not be satisfied with personal success within the bounds of our profession, essential as this is, but will drive us on and out *with other* citizens:

Text of an address delivered in part at the Annual Dinner, Hotel Pennsylvania, New York, N. Y., Dec. 4, 1946, in connection with the 1946 Annual Meeting of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

(*a*) To carry out share of the burdens of the world's problems.

(*b*) To assume our constructive part in responsibility for good, wholesome government.

(*c*) To take seriously our part as engineers in helping to resolve differences in social industrial conflict areas.

(*d*) To help in making secure these precious freedoms, among them the right without fear to write our "Letter to the Editor" and to the congressman.

Yes, the problem that troubles one most when considering the individual engineer and his public responsibilities is that of motivation. How can he be aroused from his state of inattention—apparent indifference?

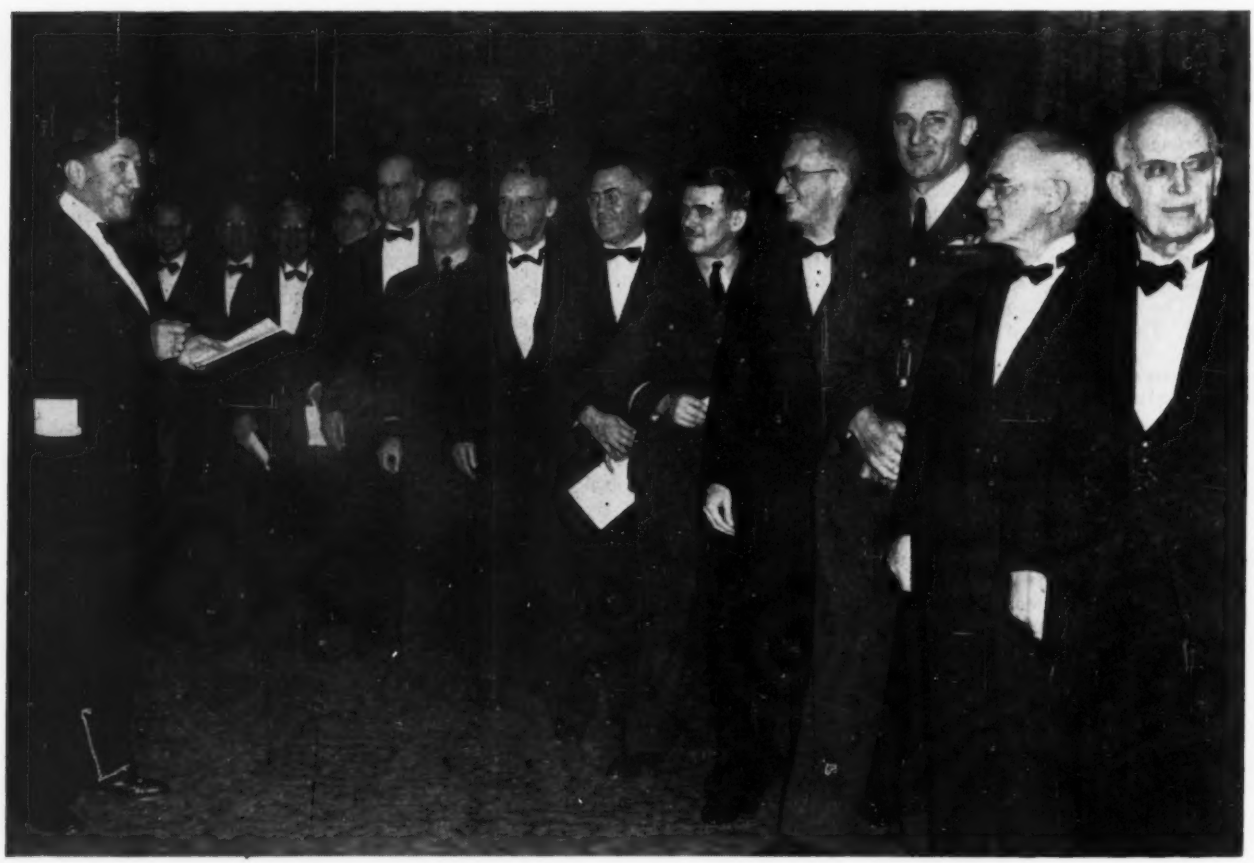
In such distinguished company it may seem sophomoric, and yet I venture to say a very brief word on this subject.

I am one of those engineers, and I believe there are many such, who believes with Dr. Richard Cabot, in his "What Men Live By"—a book much read during and after World War I—that there are four essential elements in the well-rounded life: work, play, love, and worship—work as in our vocation, craft, or profession; play as in our hobbies; love as in our family relationships; and worship as in our church affiliation.

No matter how we strive to help build a sense of public responsibility, such will not be completely effective unless or until some inner motivation drives us out and beyond the narrow confines or boundaries of our profession and compels us to go the "second mile" and use our engineering gifts in working with others for the good of the community of which we are a part.

Our material growth has been and continues to be rapid and far-reaching. Our research laboratories pour forth advances in pure science, new devices, new processes. In the years of Peace now upon us, cannot engineers afford to divert some of the precious time available for direct public responsibility? And in such responsibilities I would place better industrial relations in American industry high on this list.

By way of emphasis, and finally, let us remember that intellectual efficiency must be combined with spiritual insight if we are to make effective "that old, old theme of our profession—simple ministration to the people."



ERNEST HARTFORD, EXECUTIVE ASSISTANT SECRETARY, A.S.M.E., CALLS THE ROLL AS THE PROCESSION TO THE DAIS FORMS FOR THE 1946 ANNUAL HONORS NIGHT DINNER OF THE A.S.M.E.

(*Left to right;* Ernest Hartford, Troels Warming, Morris E. Leeds, Irving E. Moultrop; Lewis K. Sillcox, A. G. Christie, Sir Guy Garrod, D. Robert Yarnall, Eugene W. O'Brien, Air Commodore Frank Whittle, Theodore P. Wright, Group Captain R. J. Legg, Norman R. Gibson, and George I. Rockwood.)

SOME THINGS WE HAVE LEARNED

By SENATOR RALPH E. FLANDERS

PAST-PRESIDENT, A.S.M.E.

WILLIAM JAMES tells us that we go on reacting automatically in accordance with our habits and our training, until we strike an obstacle. Then we start thinking.

During the roaring twenties there seemed to be no obstacles. It is true that we began the decade with a mild depression and that we slowed up our industrial progress a bit around 1926, but on the whole it was a period of increasing activity, production, and prosperity. It was also a period in which business was in the saddle. It had everything its own way. In particular, the federal administration was sympathetic to the business point of view and on the whole enacted legislation and enforced it in accordance with the opinions and ideals of businessmen. This line of policy justified itself year after year until the fall of 1929. Then the structure crashed and we entered upon the lean years. The crash left us first incredulous, then bewildered, and then with a deep feeling of frustration.

Engineers felt a particular concern. Throughout the early thirties the depression was the main subject of thought and discussion in engineering circles and showed itself in a flood of addresses, papers, articles, and correspondence in our professional journals. The effect was in large measure a permanent one, since the engineer's interest in this matter of maintaining employment and prosperity still continues.

It is proper that this should be a continuing concern of our profession. We live in a world which the engineer has made. This world that he has made is capable of producing and has produced the highest material standard of living that our race has ever experienced. We are properly perturbed when we find that these material blessings which we have made possible suddenly cease to descend upon mankind in the profusion to which we have become accustomed. We are more and more concerned if these showers of blessings hold off year after year.

That is what happened in the great depression. It was unexpected. Its depth and its length exceeded anything in our experience and, to put it plainly, it seemed utterly foolish. Our natural resources remained. Our industrial equipment was intact. Our national skill in production remained. Millions upon millions of workers retained their skill of hand and experience, and ardently wished to make the things which they desired to enjoy and consume and which had suddenly failed them.

Many of you, active in the Society at that time, will remember that we met the situation as best we could. In conjunction with the other Societies, we established an Employment Service. Through the Engineering Council in Washington, we endeavored to analyze the causes of the paralysis which had hit us. Much good came out of this. The Employment Service was useful. The economic studies gave clear ideas to many of us as to the nature of the industrial structure we had built up, but no blinding gleam of light came; no panacea was discovered; and all this time we were launching forth into the world a lost generation of young people, born into an unending depression and seemingly unable to turn the will and the ability to work into effective support of themselves and those dependent upon them.

During this period we made a near approach to the destruction of our political, social, and economic institutions. They gave every appearance of having failed us. Why should we stand by them any longer?

Then the New Deal moved in. It was full of imagination and activity. Through the NRA it endeavored to set such prices and such wages as would encourage production and provide purchasing power. This being slow in action, it organized plans for spreading work, not clearly realizing that this was merely another name for spreading unemployment. Then government spending for government construction was undertaken on a large scale—then outright relief through the distribution of supplies and of money. All of this culminated in heavy deficit financing.

Meanwhile devaluation of the dollar had been undertaken. Other controls were established and new experiments undertaken almost monthly.

While we did climb away from the heavy unemployment figures of the depths of the depression, none of these imaginative and actively pursued policies, singly or together, were able to really solve the problem of unemployment and production. We went into our war production with still seven or eight millions of people unable to find work and therefore unable to add to the goods and services which both the employed and the unemployed so urgently needed.

The solution for unemployment was found in war. War may be right or wrong depending on the circumstances, but there is no question in the mind of any American that war is an evil and not a good. Looking at it solely from the standpoint of the expansion of employment and production, it is plain that the war enormously expanded the production of articles which none of our citizens wanted to consume or enjoy, and that the abolition of unemployment brought about by the making of these things brought high wages to purchase a low supply of goods and did this at the cost of enormous national deficits. Deficit financing of the New Deal period sinks into insignificance as compared with the deficit financing of the war.

In many ways we have not done too badly in the period since V-J day. We have lived in continuous confusion halfway on a war basis and halfway on a peace basis—halfway on a managed economy and halfway on a free economy. Strikes have seriously upset our production and consumption, but on the whole the period since V-J day has been one of progress. The transition from war to peace was made without serious unemployment and such productive capacity as was free swung quickly around to making of peacetime goods. But the fog has not yet cleared from our minds. We are told that we may expect a recession in a few months. The problems of stability and of labor-management relations are unsolved and they have cut deeply into the supply of things which the workers themselves were entitled to purchase and consume. Is there a way out?

An address delivered at the Annual Dinner during the Annual Meeting, New York, N. Y., Dec. 2–6, 1946, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Let me be rash enough to set down in order some of the things we have learned or should have learned from the history of the past twenty years.

We have learned that *progress is not automatic*. This is a new idea to Americans. We have always gone on the assumption that it is so, and except for brief spells of difficulty, our assumptions have been justified by the results. But we can no longer be assured that economic progress is automatic in this country.

It is dangerous to grasp in the present for future profits. The whole flimsy, speculative structure of 1928 and 1929 which crashed in September of the latter year, was an endeavor to realize on hoped-for future returns. On the basis of these hopes, securities were bid up far beyond any present or immediately prospective values. When these hopes were seen to be baseless, prices collapsed and the holders lost enormous sums of money. The safe and sensible thing to do is reckon on the profits of the present and the immediately foreseeable future, and to do the latter only under circumstances which are very clear. Discounting the future is dangerous for the individual. When pursued by millions of individuals, it is disastrous for the nation.

The economic system which produces a high level of income and consumption is inherently unstable. In retrospect we can see this quite clearly. A people living on a low standard of living is steady in its expenditures. By grim necessity, it spends everything it receives for the essentials of food, clothing, and shelter. When, however, production and resulting incomes rise to the point where those incomes do not have to be immediately spent but can be saved or used in speculative undertakings, then we reach a situation in which there will be from time to time periods when the money return from the processses of production and distribution does not flow back into the market to purchase the things produced and distributed. Furthermore, our whole economic process is so involved that, as compared with a simple agricultural economy, maladjustments at one point are liable to spread through the whole. This is particularly true of our unstable operating system of money and credit.

Prolonged unemployment raises the danger of the destruction of our social and political institutions. Mention of this was made earlier. The danger cannot be laid as a whole at the door of any particular individual in the government who may have come into power during times of trouble. The situation itself is explosive. I well remember in the summer of '32 going south from Washington on the Crescent Limited and having the train stoned, not by boys, but by men hiding in railroad yards at the south end of the tunnel. Unemployment in a country full of raw materials and production equipment affects the human being in a different way from that of the famine and pestilence which our forefathers classed as "acts of God." It is too easy to call the unemployment of the thirties an act of God. We had better take our full measure of responsibility for it and call it an act of man.

Unemployment cannot be cured by detailed planning in a free society. This lesson is stated categorically. About every plan that could be made was planned and carried out. None of them worked. Is there in this world a brain or a group of brains which can manage the details of a free economy? We have not seen it yet. I doubt if we ever shall.

Prolonged unemployment cannot be cured by deficit spending. This is certainly true on the scale applied to the problem during the thirties. Later schools of theorists have asserted that if we had only run a much higher deficit, we could have cured unemployment. This is barely possible but we have no experience to indicate that it is true, and no insurance that the resulting evils, such as a great increase in the debt, may not in the end result in as large unemployment as the original action was intended to cure.

We can be successful in managed co-operative production for war purposes. The reasons for this are clear. The whole nation has but one objective and that is the successful completion of the war. Every other desire gives place to this. So long as we are convinced that a war is being handled wisely, so long will we submit to direction of our activities, and restrictions in kind and amount of our purchases and consumption.

Detailed control of a free people cannot be accomplished in peacetime. The reasons here are clear. In war, as was said, we had but one objective. In peacetime one hundred and forty million people have each their multitude of appetites, desires, and objectives—many of which reinforce each other and others of which conflict. Only by the regimentation of this multitude of desires, bringing them into a few standardized kinds of goods and services, can production and distribution be effectively organized. A free people like ours will not be regimented. Regimentation being impossible and the carrying on of the complicated processes of the innumerable varieties of goods and services being impossible, this one of our lessons remains true. We have indeed verified it by trial and error.

Thanks to the work of the engineer, this life of ours has become tremendously complicated. It can become disorganized almost as easily by lack of technical efficiency; but we must not forget that the improvement of our material conditions and the steadying of the fluctuations to which they will be more and more subject is dependent on the close co-operation of high morals with skillful business, financial, technical, and political techniques. It is not true now, if it ever was, that "just the art of being kind is all this sad world needs." What is needed in the service of mankind is the whole of man—body, heart, and mind—all working together.

Again this seems to be something obvious, yet it is a badly neglected piece of obviousness. Technicians tend to forget the necessity for moral strength in a people. The moralists tend to be ignorant of the necessity for technical proficiency in our elaborate social institutions.

Many years ago the poet Tennyson looked forward, though in another connection, to the solution which our generation is seeking, when he envisioned a future in which "heart and mind, according well, shall make one music as before." To attain that divine harmony is the chief end of modern man.

We cannot consume and enjoy what we do not produce. This would seem to be so obvious and elementary as scarcely to need mention. Yet many of us have been continuously ignoring this simple fact. Union leaders have ignored it in assuming that the standard of living of the wage earner can be raised without increasing production. But union leaders are not the only ones guilty of attempting the impossible. Fundamentally, the same erroneous thought led to that wild speculation of the late twenties, in which businessmen sought to benefit by realizing in the present on wealth which could be produced only in the distant future. We have all sinned in this matter and it is not proper that we should point the finger of scorn at each other. We can be mutually helpful in passing on to those now engaged in ignorant actions, the wisdom which others have learned from similar faults of the past.

Our material prosperity depends on the co-operation of our whole people. We are tied together in a thousand ways—merchants, railroad people, industrial wage earners, farmers, bankers, and professional men. No one class can cease its proper functions without harming and embittering the whole. In particular, in this new day of nation-wide industries, nation-wide unions, and nation-wide strikes, a striking wage earner is not so much striking against his employer as he is striking against other wage earners and finally against himself. The day of local strikes with local effects has vanished. The day is with us of applying painful pressure to the whole population of the nation in bringing a group of employers to terms.

All these things we have learned and they are for the most part negations. They tell us so many things we cannot do without danger to ourselves and our fellow citizens. They do not give us much, if any, light on what we ought do to. What is the positive to balance against these negatives?

The maintenance of a high level of productive and profitable employment is the major material problem which faces us right now in the United States. It seems clear to me at least that there is no one grand solution, or indeed any set of measures large or small which can of themselves do what we wish to be done. As a freshman Senator let me say that my own rule of action will be this: First, to recognize this problem of the maintenance of employment as the major internal problem of the nation; and second, to judge every measure proposed and coming to a vote in the Congress by a simple criterion if it is applicable. I will ask the question—What will be the effect of this proposed law on the maintenance of productive profitable employment? If we all accept this as the basis of our judgment and if we are not too mistaken in our judgment as to the effects of such legislation, I am sure that the problem of maintaining employment will be much simpler and the means much more effective than they have been in the past.

In passing judgment on proposed legislation or administrative action in this field, we must remember the difference between long-range and short-range objectives in social well-being. Referring again to William James, a young friend of his wrote a thin volume entitled "Foundation of Ethics," in which he made a very clear and forceful argument for the proposition that the difference between right and wrong action is fundamentally the difference between the long-range and short-range benefits. It would have been well if the business and financial speculators of the late twenties had kept this point clearly in mind. It would be well if the labor leaders of today did the same.

Let's return again to that point mentioned earlier—the necessity for co-operation of all the innumerable groups that make up our population. There is no clearer statement of this necessity for co-operation than that given by the Apostle Paul in I Corinthians when he elaborated his figure of the body and its members. Some of the members had more important and elaborate functions than others, but this did not entitle them to look down on the more humble members. All were necessary. The health of the body depended on the proper action of each and the health of each depended on the health of the whole body.

These things are said so often that we have become morally calloused with respect to them. They are none the less true, however little they find acceptance as a normal rule of action in highly industrialized communities or societies.

Yet there are certain tribes which have practiced the general interest to an astonishing degree and from them we can learn some lessons. For instance, lessons can be learned from the social habits of the Eskimos, and there is no more interesting source of information on this subject than Peter Freuchen's story of his life among these people. The Eskimos are perhaps unique, in that they have developed the technique of co-operative action just to the point, and no further, that will serve them in maintaining their individual lives and their social life under conditions of extreme physical severity and difficulty.

Another case is to be found in one of the tribes of New Guinea, whose institutions are described by that very readable anthropologist, Margaret Meade. In this tribe we find the golden rule established as the guiding principle. Each family tends another family's gardens and neglects its own. Co-operation seems to have become sentimental or emotional rather than practical, as in the case of the Eskimo. The results are that agricultural production is spasmodic and in all probability less efficient than in those tribes in which private interest is a much stronger spring of action.

I mention these two examples because they lead up to the point of view which I wish particularly to express here this evening. It is this—that whether by failure of businessmen to do as they should or by the failure of wage earners to do as they should, or by the failure of any other class, depressions come and social maladjustments are prolonged. These are failures to live up to Christian ethics. Christian ethics cannot be denied. It will inevitably take its toll if it is disobeyed. But the second point to be made is this—that the moral attitude is not enough and Christian ethics is not enough. Even Christianity itself, if interpreted too narrowly, is not enough. All this in a way says that good will is not enough.

Thanks to the work of the engineer, this life of ours has become tremendously complicated. It can become disorganized almost as easily by lack of technical efficiency as by lack of moral stamina. Fortunately or unfortunately, we have lacked moral stamina to a greater degree than technical efficiency; but we must not forget that the improvement of our material conditions and the steadying of the fluctuations to which they will be more and more subject is dependent on the close co-operation of high morals with skillful business, financial, technical, and political techniques. It is not true now, if it ever was, that "just the art of being kind is all this sad world needs." What is needed in the service of mankind is the whole of man—body, heart, and mind—all working together.

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OUTLOOK *for* FREEDOM

By PAUL G. HOFFMAN, GANTT MEDALIST, 1946

PRESIDENT OF THE STUDEBAKER CORPORATION, SOUTH BEND, IND.

I AM delighted to have received the invitation to speak at this luncheon of the Management Division of The American Society of Mechanical Engineers because of the opportunity it offers me to share my worries with an exceptional group of men—worries that are concerned directly with the preservation of our free economy and our free society. Unlike some people, I believe we should do some worrying provided it is directed toward definite objectives. I like to call it "successful worrying."

To worry successfully about a problem requires an engineering approach. Engineers know that unless they get the facts, the facts will get them. They know that neither emotional outbursts nor name-calling are resultful. Furthermore, they are willing to *face* the facts and translate them into a rational plan of action. In short, engineers make much sense.

LABOR-MANAGEMENT RELATIONS

I have plenty of worries but I am going to be reasonable. I propose sharing only three of them with you. The first worry I want to share with you is that of labor-management relations. Our failure successfully to worry about that problem already has cost us billions of dollars. It has also put in jeopardy our entire reconversion program.

Figures tell only part of the story, but for what they are worth I should like to cite a few which represent an estimate of the enormous economic loss which strikes have caused during the first nine months of this year. According to the Bureau of Labor Statistics 98,225,000 man-days were lost because of strikes during this nine-month period. That is an all-time high, according to the B.L.S., and compares with an average of 13,630,000 man-days lost in corresponding periods during the years 1935 to 1939. These figures would indicate a loss to workers of at least $750 million in wages. I am sure you will agree that these figures are appalling, but they tell only part of the story. They cover only the direct wage loss as a result of strikes. They do not include collateral losses of wages and profits in trade and service industries, nor do they include the production and wages lost in industries forced to shut down because of strikes outside their own plants. I know from personal experience how staggering losses of this kind can be. I think you will appreciate its seriousness when I give you the following data concerning the company with which I am associated.

Studebaker, unlike most of its competitors, was able to reconvert to peacetime operations without a strike in its own plants. Nevertheless, the indirect cost of strikes to us has been tremendous. From October 1, 1945, to June 30, 1946, Studebaker was scheduled to produce 134,500 passenger cars and trucks. But what happened? Through no fault of ours, we produced only some 43,000 units during this nine-month period, and our failure to attain scheduled production was due almost entirely to strikes and slowdowns in plants of our suppliers. This failure cost our employees approximately 15,000,000 man-hours of work, or more than $20,000,000 in wages, and deprived our transportation system of some 90,000 badly needed automotive vehicles.

From figures such as these it is apparent that labor and management must bury the hatchet if our economy is to survive. We cannot long continue to suffer the staggering losses that have befallen us during the past year. In my opinion, two major moves are necessary. First, we must have a new set of ground rules controlling collective bargaining. In this connection, an intensive study of the entire problem is being made by a special committee of the Committee for Economic Development. To show you what I mean by a new set of ground rules, let me tell you about one of the many suggestions that has been made before our special committee. It has been suggested that the rules governing collective bargaining should by their very nature put pressure on both management and labor to rely upon persuasion rather than coercion for the attainment of their objectives. For example, management should be prevented from entering into collective-bargaining negotiations with the authority from the owners of the business to stage a lockout if its terms are not met. Similarly, labor leaders should not be permitted to enter negotiations with a blind strike vote in their pockets. True bargaining cannot be carried on when either party is pointing a loaded and cocked gun at the other. If management and labor fail to reconcile their views after negotiations under the new ground rules I have outlined, then both sides should be forced to tell their story in full and in writing to the people who would suffer most as a result of a strike or lockout—management disclosing the terms of its most favorable offer, labor leaders revealing their reasons for refusing to accept it. Then, and only then, should the people involved—the owners and the workers—be asked to empower their respective representatives to resort either to a lockout or a strike. This illustrates what I have in mind.

The second major move required is a change in attitude on the part of both management and labor. Today, emotion plays too great a part in collective-bargaining negotiations. Both parties too often enter negotiations with a chip-on-the-shoulder attitude. They are both ready to fight at the drop of a hat. Rather than to hanker to fight each other, both employers and labor leaders should be determined to fight for peace—to fight for a quick settlement of their differences. And the major responsibility for a change in attitude must rest with employers. We've had long experience in leadership and it's strictly up to us to prove to our own people and to the general public that above all we propose to fight and fight hard for industrial peace. Only if we are able to achieve this change in attitude can we hope to make collective bargaining work.

Unless management and labor demonstrate quickly a desire and an ability to bargain collectively, they face the risk of legislation based on emotions rather than reason. The public already is in a dangerous mood as a result of our strike experience since V-J Day. The results of a Gallup poll published only a few days ago reveal that fully 50 per cent of the people reached by this poll favor legislation which would prohibit all strikes and lockouts for a year! Some 66 per cent of the people canvassed are in favor of Congressional action which will control labor unions. If this mood should express itself in the form of punitive legislation directed against labor unions, the results would be as unfortunate for management as for workers. We want new ground rules, yes, but ground rules that will promote peace rather than bitterness and conflict.

An address delivered at the Management Luncheon at the Annual Meeting, New York, N. Y., December 2–6, 1946, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

HOW CAN WE COMBAT INFLATION?

The second worry I want to share with you concerns inflation. Only last month I was in Europe. There I saw the havoc which inflation causes. I saw the paralysis which inflation breeds, the problems which it creates. I hope this nation will never be called upon to grope its way out of the ruins resulting from the uncontrollable fury of inflation. What I saw made me more determined than ever to work for measures which will choke the inflation threat before it has a chance to get started.

How can we combat this menace? There are many things we can do, most important of which, in my opinion, are:

First, we must increase productivity. High productivity cuts unit costs and increases supplies in relation to demand. Only by increasing productivity can we raise *real* wages. At the same time we must, as individuals both singly and collectively, use restraint in raising prices, wages, and salaries because nothing could be more dangerous in the present situation than to start another upward spiral in wages and prices.

Second, both individuals and businesses should refrain from making deferable expenditures for the time being.

Third, we should all support vigorously the Treasury Department's campaign to sell series E and F bonds of small denominations.

Fourth, governments—national, state and local—should quickly reduce expenditures and defer projects not urgently needed at the moment. All should maintain tax rates at a level sufficient to yield revenues well in excess of expenditures in the fiscal year ending June 30, 1947.

If we can push measures successfully, we need have no fear of inflation obtaining a stranglehold in America. They will, I am confident, take us safely through the dangerous period which confronts us.

A third and last worry I want to share with you concerns the belief on the part of so many people that another major depression is inevitable. In the last few weeks, both here and abroad, almost everyone I have met has asked the same question, namely: "When is the big bust coming?" Everyone seemed to take it for granted that the United States was inevitably headed for another big depression. The question was never, "How can we avoid another major depression," but always, "When is it coming?"

This almost universal acceptance of the inevitability of another major depression reminds me of a similar attitude which prevailed in certain circles as to the inevitability of mass unemployment in the first year of peace. You may recall that not long before V-J Day experts both in and out of government were predicting there would be six to eight million unemployed by Christmas, 1945. You may also recall that when the Committee for Economic Development early in 1943 suggested a postwar goal of 53 to 56 million civilian jobs it was severely criticized by some segments of business for setting an objective which could never be reached and therefore would prove to be a tremendous embarrassment in the postwar period. You know, of course, that we not only have had no substantial unemployment since V-J Day, but on the contrary, that we have today some 58 million civilians employed—far more than in any previous peacetime year.

Not for one minute am I suggesting that C.E.D. should be given credit for what happened on the employment front. After all, it was only one of many agencies urging and assisting businessmen to plan for a quick expansion of their enterprises immediately after the war so as to avoid the lag in production and employment that would otherwise take place. Nor am I, in reciting this employment story, suggesting that by any activities on our part at this time we can reach the millennium and maintain an uninterrupted state of high prosperity. I am simply proposing that we would be well advised to vigorously challenge the notion that we should sit idly by and await the coming of a disastrous business collapse. After all, both booms and busts stem from the activities of men and therefore are in a manner of speaking made by men and as men we can and should deny that our American economy is foredoomed to this boom-bust cycle.

I hardly need point out the dangers with which we should be beset if we should be afflicted with another major depression with its millions of unemployed. It would be a heyday for panacea peddlers. Measure after measure would be proposed, many of which, if enacted, would so vitiate our capitalistic system that it could not function. If you agree that we want to preserve our present system, then I am sure you will agree that we should take action *now* aimed at the avoidance of another great depression.

Before we attempt to lay out a detailed program with that aim, I believe we should take a long hard look at our economic system and try to find out what causes the fluctuations in the level of business. Free economies, largely in consequence of their freedom, are subject to powerful influences that induce instability in business activity primarily through affecting market demand. Market demand for goods and services is, of course, made up of the combined demands of individual customers— consumers, business firms, and the government. At any given time market demand depends upon: (1) How much cash or credit is available to customers, businessmen, and the government; and (2) how much of that cash or the proceeds of that credit they are willing to spend for goods or invest in business assets.

Instability in market demand results from a complex set of factors. Among these are: High standards of living; the large capital investments required for modern business; the credit system; the tax system; and the influence of foreign trade.

Paradoxically, the most important single factor in creating instability in market demand in the United States is our high standard of living. When you give thought to it, the reason is obvious. If most of us are just barely able to earn a minimum living, we will have little choice as to what we buy or when we buy it. Our money will go for food, clothing, and shelter that we have to have regularly. On the other hand, the more money we have beyond what we must use for basic needs, the more chance we have to choose what we buy and the larger the number of purchases which we can postpone. And we all know that as a result of these options individuals often defer buying even though they have ample cash or credit.

What is true of the individual buyer is true of business. Business can postpone its purchases even more easily than individuals. Modern competition makes business put more and more of its money into capital goods—buildings and machinery, office and store equipment, and inventories—to make possible low-cost production and to provide the values and services which buyers demand. If businesses do not make such purchases, the savings of both individuals and businesses cannot find their way into the stream of active creative capital. But businessmen will make investments in such capital goods only if there is promise of a reasonable profit; so these purchases are postponable. When chances of profit are dreary, investments are often put off even though ample cash reserves are on hand.

Credit is another important factor. Whether money is "easy" or "tight"—whether credit is obtainable generally at a low or a high rate of interest, or not at all—is determined: (1) by policy decisions in the public treasury, in the central banking system, and in other government agencies; (2) by the actions of public supervisory authorities; and (3) by the numerous decisions made by individual bankers and others who grant credit in the light of their appraisal of the business outlook.

These decisions at times have an all-pervasive and crucial influence on business activity. In general their net effect has been to make credit more easily available in prosperous times and less easily available in depressions, thus widening the periodic swings in market demand.

Taxes also affect market demand. The influence of taxes on the stability of incomes, and hence on the stability of demand and employment, takes on new importance with every increase in the percentage of total national income absorbed by taxes. When taxes take only a small percentage of total national income, they are probably a factor of minor importance. With expenditures in the postwar period reaching levels that may require as much as 15 to 20 per cent of the national income, the structure of the tax system and the amount and timing of tax collections become factors of primary importance. By collecting too little in taxes in periods of prosperity and too much in periods of depression, the tax system operates to encourage inflation and to deepen depression.

Economic instability in any country has its effects on the rest of the world. A special source of instability arises from losing foreign markets on short notice, or without warning, because of restrictions adopted by foreign countries. The loss of foreign sources of supply because of export restrictions abroad is a less common but possible source of instability. The use of state trading monopolies and trade restrictions for political purposes creates a special hazard because of the unpredictability of the changes in policy.

These major sources of instability operate in our free economies through the decisions of many millions of consumers and many thousands of businessmen. It all nets down to this—that before we can have adequate market demand there must be both the power to purchase and the willingness to spend on the part of individuals and businessmen. If we consider measures aimed at the maintenance of economic stability we must give due weight to the necessity of confidence on the part of individuals in the continuity of their incomes and confidence on the part of businessmen in the prospects of a profit.

Now I should like to suggest the specific areas in which government should take prompt action to promote greater stability in our economy:

First, our tax system must be revised to help counteract both inflation and deflation. This should not be too difficult. As a basic principle of tax policy our tax rates should be set to balance the budget in a period of normal prosperity and then let alone. In a year of high prosperity (such as the present fiscal year) a substantial surplus of receipts over expenditures should be produced. In a year of low business activity there would be a deficit. On the basis of our past economic history, we have every right to expect that in any normal cycle of years conditions would average out at something better than normal prosperity. That means, of course, that in such a cycle receipts would exceed expenditures. The significant feature of stabilized tax rates is that they result in the collection of a high volume of tax dollars in periods when inflation threatens and a low volume of tax dollars in periods of depression.

Second, federal and local governments can help stabilize the economy through better timing of public works. In the past we have had the greatest volume of public works during times of prosperity and the lowest volume during depressions. It ought to be the other way around. If we are to have a sensible program, we must have advanced planning—by planning I mean blueprinting, together with detailed schedules for financing. Some public works cannot be postponed, but as much as possible public building should be timed to combat the fluctuations of the economy.

Third, our government should expand and consolidate unemployment-compensation coverage. So far, we have made only limited use of unemployment-compensation insurance as a social tool, but its effectiveness has been dramatically demonstrated. It gives to people the confidence in continuity of income which is so essential to the achievement of greater stability in our economy. It also makes a tangible contribution through the maintenance of purchasing power. We should not allow the circumstance that there has been considerable maladministration of unemployment-compensation insurance to blind us as to its benefits. Our aim should be to extend it as far as practical to all workers. Payments, of course, should never be large enough to make unemployment attractive.

THE RESPONSIBILITIES OF BUSINESSMEN

Now as to the responsibilities of businessmen for making our economy more stable:

First, the greatest contribution any businessman can make toward stability is to operate his business profitably. Every businessman owes this major responsibility to his stockholders, his associates, his workers, and the public. Only a profitable business can offer security to its employees.

Second, every employer should regularize employment in his business to the greatest possible extent. Much has already been done, but we can do more to flatten out the seasonal curve of employment in most industries.

Third, and last, businessmen should exercise scientific control of sales expenditures. In the past, American concerns have kept their sales and advertising budgets high when business was good and easy to get. Sometimes some of these expenditures were questionable. When business was slow and sales tough to get, sales and advertising were pared to a minimum. This is neither good business nor good sense. If we are to have a stabilized market demand, selling pressures should be maintained, perhaps increased, at the first sign of a decline in business. We must avoid spending sprees when business is good so that reserves will be available when extra pressure is needed. I know of no single way business managers can do more to help stabilize market demand than through greater stabilization of sales and advertising expenditures.

Perhaps I have said enough to make clear the magnitude of of the task that lies ahead and the need for all of us to engage in successful worrying. I am sure you will agree that the stakes we are fighting for are tremendous. Assuming that through our efforts we should succeed in reducing the intensity of future fluctuations by two thirds, let us see what it would mean. Between 1929 and 1932 the reduction in national income was more than 50 per cent. A similar reduction in national income today would mean a drop from 150 billion dollars to 75 billion dollars. Does any one doubt that such a loss would put our system in the greatest hazard? On the other hand, if we succeeded through the application of proper measures in reducing the intensity of future fluctuations by two thirds, it would mean that the maximum drop in national income from present levels would be less than 25 billion dollars. I believe we could take a drop of that extent without serious repercussions. Does anyone doubt that here and now we should be putting forth our best effort to achieve a reduction in intensity? Does anyone doubt that if we are successful the outlook for freedom will be definitely brightened?

Perhaps mine is the voice of an optimist but I sincerely believe that during the next 25 years the progress we will make will be without parallel. If we remain at peace the real income of most of our people can be doubled. We can also largely realize the age-old dream of abolishing poverty. Most important of all, on this material foundation we can build conditions which will provide not only equality of opportunity but certainty of opportunity for every man, woman, and child to grow and develop intellectually and spiritually.

THE PUBLIC RESPONSIBILITY *of the* ENGINEER

By CARL HINSHAW

MEMBER OF THE HOUSE OF REPRESENTATIVES FROM THE 20TH CALIFORNIA DISTRICT

THE engineer seldom offers himself for election to public office and yet his kind are badly needed. There are pure theoreticians and there are men who are essentially practical, but the engineer is that unique synthesis of the theoretical and the practical that is so badly needed in the service of the public today as leaders.

Why are so few engineers to be found in elective public offices? Every government and subdivision of government employs one or more engineers either in a professional capacity or in a managerial capacity where he is subject to the direction of a politician or a politically composed legislative body of some kind and the engineer seems content for it to be so. He is the servant of the servants of the people. Why should that be? Why does the engineer shun the political contest which leads to leadership? I think it arises from the very nature of his early training and his professional experience. He is thereby inhibited from vocal expression in public. He becomes shy of public contacts because of the very power and yet the limitations of his knowledge. The engineer is essentially a specialist, frequently to the complete exclusion of any outside interest.

THE ENGINEER A LONE WOLF

That characteristic begins to become particularly noticeable early in the course of those educational institutions where an engineering college is an appendage to colleges of the liberal arts and sciences. There the engineering student spends most of his afternoons in the drafting room or laboratory and his evenings with his nose buried deep in signs and symbols that are more Greek to the liberal-arts student than Greek itself. In his sophomore year the engineering student becomes almost completely separated from his fellows of the arts and sciences, and in the course of the remainder of their formal education they are in worlds apart. In the educational process leading toward other professions such as law and medicine, the important professional work is taken in a postgraduate course. I have often wondered why it is not thought to be just as necessary for an engineer to learn something of economics, philosophy, and the literature of the ages as it is for those who are to engage in other professions. Why should not the engineer be grounded also in such mundane and simple arithmetic as is involved in ordinary accounting, and in such ancient usages as are found in the law of contracts and negotiable instruments? But generally it is not so. The engineer is brought up to be an engineer and nothing more and yet, at the same time, there is created in him that unique synthesis of the very accurate technician with the essentially practical viewpoint which is so highly desirable but rarely found in positions of public leadership.

In this unique synthesis of qualities so desirable in positions of public leadership, the engineer has another strong quality which is inherent in him, namely, integrity. The engineer is basically a man of high integrity because his every professional act must be subject to proof—to verification of basic facts and final proof in the test of service. From the day he first studies geometry his motto is "Quod erat demonstrandum" and that is his taskmaster to the end of his days. No matter to what end his flights of inventive genius may lead him there burns in his soul the determination to be able finally to engrave into the base of his brainchild the letters Q.E.D. for all to see. By his works he is known. He is not given to wordy promises, and he will not make a statement as of fact that is to his knowledge untrue, or even a bit doubtful. His kind are needed badly in public life.

I wonder frequently how the rest of the few of us who have broken out of our professional status and into public life, happened to crack their shells. My own story may be of interest to you and perhaps it can be told in very brief outline before I tell you a more important story.

Upon my successful graduation with the degree of civil engineer, my father, who had studied engineering and law, urged me to do postgraduate work in business administration. I wore the insignia of the Corps of Engineers from 1917 to 1920 and then found myself unemployed for several months. I lived then with an uncle who had in his library the famous five-foot shelf of classics. I went through it with a new-found thirst which has never since been quenched. Practical experience commenced for me in an automotive factory and included, in due course, management, sales engineering, sales and sales management, and then finance, when fate changed things all around. Deep family misfortune intervened to cause distaste for Chicago and send me to California where I engaged in the real-estate business, which seemed to be a common endeavor there. Then, as president of my realty board, I started a highway project that dragged me into politics willy-nilly. The project was a success and I was urged to run for Congress—just like that—and I have just recently been re-elected to serve my fifth successive term. But until I became president of that realty board in 1934 I had never stood on my feet to talk in public.

THE STORY OF SENATOR FLANDERS

However, there is a far more interesting story than mine. It is the story of your own Ralph Flanders, a member of your society of such eminence that he has served the A.S.M.E. as its president. Ralph Flanders is a man who became a mechanical engineer the hard way. With only eight years of formal schooling in the public schools of his native state of Vermont, a man who never attended any college, he has been awarded eight honorary degrees from leading American universities. Shortly after the end of his schooldays, which he terminated at the age of fifteen, he entered a machine shop to learn the machinist's trade under an old-fashioned apprenticeship system.

An address delivered at the Keynote Luncheon during the Annual Meeting, New York, N. Y., December 2–6, 1946, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

His father had to put up a $100.00 cash bond to guarantee that he would complete his three years of apprenticeship, a job which paid him at the rate of four cents per hour for a sixty-hour week. Upon the completion of his apprenticeship, he served as a journeyman machinist for about six months before an opportunity came to him to go into the drafting room where he worked for a year and a half learning that art. That period in the drafting room excited his interest in obtaining the necessary theoretical knowledge which goes with a machine designer's and mechanical engineer's work.

In retrospection of that period of his life, Ralph Flanders said: "Ever since that time, my life has been a constant pursuit of the kind of theoretical knowledge which can be turned into practical use for the improvement of the conditions of daily life, whether in machines, in business, or in the maintenance of employment and of the high standard of living in the life of the nation. My experience has taught me that the unsolved problems can be solved by those who are willing and able to bring theory and practice together."

The spirit disclosed by those words caused him to become deeply concerned with the problems of the workers in the factory which he managed when the depression of 1921 settled upon them. His personal interest in that group of men in that trying time, his fundamental humaneness, was the great force which caused him to begin his long career of public service—a career which has gone hand in hand, and side by side with his career as a great mechanical engineer. Let me quote him again. Speaking of the hard times of 1920 and 1921 and the much harder times that began in 1930, he said: "It affected the lives of hundreds of people whom I knew personally and for whom and for whose families I felt a large share of personal responsibility. There was nothing of the practical sort that could be done. Purely practical solutions were small-scale and hopeless. It was necessary to study underlying causes, and to this I have devoted my spare time for many years . . . . to bring the teachings of correct underlying theory to the solution of practical problems."

From here on, we find the trained mind of a practical engineer becoming perfected in economics and political science in the public interest, until we find him consulted by high government officials, even to the President of the United States. His public services have been so numerous and so eminently successful, that indeed he could not avoid becoming the Senator from Vermont. His term of public office has already commenced as he was appointed by the Governor of Vermont to fill the unexpired term of his distinguished predecessor, Senator Austin.

SENATOR MALONE AN ENGINEER

Another distinguished engineer will join Ralph Flanders as a member of the United States Senate in January. He is George Wilson "Molly" Malone of Nevada. Senator-elect Malone is a civil and mining and metallurgical engineer who evidently acquired his urge toward public office through his keen interest in the development of the Western States. Having served as Secretary to a Senate Investigating Committee during the war, he must have been deeply impressed by the dire need of engineers in the Senate to leaven the legal loaf by talking common sense; lawyers seem to enjoy constructing lofty premises like inverted pyramids firmly attached to the underside of a dense rhetorical cloud. It takes an engineer to bring them to earth—apex up.

MORE ENGINEERS NEEDED IN CONGRESS

But why should Ralph Edward Flanders and George Wilson Malone be the only engineers in the United States Senate? Why are not more of their kind in that distinguished company? Is it because of a lack of humaneness in engineers generally? We know that is not so, for engineers are essentially humane. Is it because of shyness? Yes, in part. The education and training of an engineer are such as to make him shy of public contacts. How can he be brought out from his shell? How can more of his kind be encouraged to offer themselves for the elective positions of public leadership? It seems to me that one way to crack his shell of shyness is to teach him to speak, to stand on his two feet and talk. He needs not to be taught to speak intelligently, because intelligence is a prerequisite for the making of an engineer, but he must be taught to speak interestingly, which means to speak fluently in lay language on subjects which he understands. That training can and should commence in the engineering colleges, if not earlier. From my own experience as an engineer, and as a public servant, I am convinced that public speaking should be a part of the curriculum of every engineering college. In order that the nascent engineer may have the "right" training in public speaking, he should engage in debates on public questions with budding lawyers, particularly, because in competing with a young lawyer he will take on an opponent who is becoming adept in the art of talking convincingly about things of which he frequently knows little. I am convinced, likewise, that economics and philosophy should be made a part of that curriculum.

To be sure, these things can be learned the hard way as Senator-elect Ralph E. Flanders has learned them, but the inciting of original interest in those subjects in the engineering-student's mind would bring many young engineers to the fore in public life at a much earlier age than either Ralph Flanders, or I, in my lesser way, have so found ourselves. In the House of Representatives we have another engineer, a chemical engineer, in the person of Gordon MacDonough, of California, so there are now four of us; two among 435 in the House of Representatives, and two among the 96 members of the United States Senate. We are very much alone.

TIME FOR CLEAR THINKING

From my own eight years' experience in the House of Representatives, I can foresee some of the trials and tribulations which Senator Flanders will experience in the United States Senate. As a Junior Senator, he must be in evidence but not heard for some time to come. He must learn the rules and bide his time. The day will come when he will rise from his place and speak because the truth is in him and must come out. It is to be hoped that many of his colleagues will be present when he first speaks, but his genial personality will cause some one of his newfound friends, perhaps, to ask for a quorum before he speaks. That first address will be his greatest test, so he will bide his time.

His colleagues will recognize the profoundness of his remarks and in due course will consult him on matters concerning which he is so well qualified to speak authoritatively. His reputation will grow among his fellows until the quorum call will merely become a notice that Ralph Flanders is about to speak. I trust that it will take a shorter period of service to arrive at that point in the United States Senate, composed as it is of 96 statesmen and practical politicians, than in the House of Representatives, where there are 435 just good plain American citizens. From that day forward Ralph Flanders will be a strong power to be reckoned with in the Senate of the United States because truth in that place is the power that finally controls. When the truth is absent, queer things happen; but when truth is present and expressed in terms that must be understood, then straight thinking ensues.

There should be more engineers in city councils, in state legislatures, in the Congress of the United States, and in the positions of executive authority everywhere in the body politic of our country. The mechanical age which the engineers have created demands engineering leadership in public life.

This is an exceedingly critical juncture in the history of the world as a whole and in the history of our own country in particular. We are at a great divide in the highroad. One way leads to the left and the other goes straight ahead. Strong forces are pulling us to the left. Obstacles of serious proportions are being strewn in the road that leads straight ahead. A storm blows from the right that we must lean into in order that our course shall not deviate.

This is the time for clear thinking and correct appraisal. This is the time when that practical theoretician, the engineer, must take the lead everywhere. He must find words with which to express the great truths he knows, words that will bring understanding of truth to those who would chase after the rainbow to the left, on the road that leads to obliteration of individual liberty.

RUSSIA'S "ECONOMY OF A PRISON"

Let us not mince words but speak the truth. Those who would lead us to the left draw a picture of a life that few persons now outside of the Soviet Union have ever seen. It is an enticing picture of the planned economy with full employment and a fair share of the products of that employment. Those Americans who have experienced the life in Russia as erstwhile ardent advocates of that system and who have been able to escape from it to return here, have been cured by their experience. Engineers who have gone there to render professional services under contract have returned, cured of any leanings they may have had. It is the economy of an enormous prison. Any good penitentiary provides full employment and the maximum of security to its inmates.

There is no need here to discuss the Soviet system, except to reiterate that we don't want it in America. I mention it only because its advocates and agitators in this country are attempting to destroy what we have built in order to bring poverty, distress, and revolution, a turmoil in which they, being trained revolutionaries, may hope to achieve mastery over us. These people incite strikes and slowdowns as instruments of destruction. They know that if our system of production and distribution can be seriously crippled then distress and poverty will rule, and revolution may follow.

But let the clear voice of truth be heard in this turmoil, and the people will listen and understand, and will turn toward truth to lead them. The engineer knows the truth. Let him speak it wherever he may be.

You are mechanical engineers. Your kind are in the great machinery-manufacturing and the mass-production industries that employ millions of workers. You have the basic information, but do you translate it into simple truths that anyone can understand, and that all men of good will should know? For example:

LABOR COST PER AUTOMOBILE QUADRUPLED

In the automobile industry, the production of cars and trucks is down 10 per cent below prewar averages while the number of hours of labor has increased 78 per cent. That is to say, we have 90 per cent of production from 178 per cent of the hours of labor. That means there is almost a 50 per cent slowdown. It takes nearly twice as much labor to produce an automobile today as it did from 1935 to 1939. But wages are up nearly 100 per cent, too, so the cost of labor in dollars per car is four times as great as prewar times.

What does that mean to the worker? Today he gets twice as many dollars as he used to get—but he can buy only half as much as he used to be able to buy. If everyone was paid a million dollars a day and nobody did any work, the million dollars would be worthless because there wouldn't be anything to buy. So let us find the basic truth and tell it to everyone: It is more production that makes the wages worth more.

WORKER SLOWDOWNS THREAT TO ECONOMY

The workers in many places have been taught by their leaders that to slow down would "spread the work" and that the slowdown would provide more work and more jobs. That false theory became prevalent during the thirties and has been revived since the war for sinister purposes. It appears logical to the worker because he sees only the job on which he is assigned. He does not see clearly that the slowdown increases the cost of the article he is making. He sees only that the things that he buys for his living today seem to go up in price. So he wants higher pay, and in fact, he does need more money to maintain his living standard. But higher pay only adds further to the costs and his accustomed living standard goes out of reach again. The immediate result is strikes and then shortages and more slowdowns. It is a vicious cycle that, unchecked, can end only in death to our economy.

The worker must be taught the truth and learn the basic facts. He must unlearn the false theories of the thirties and learn that it is greater production per hour that makes abundance at lower cost and his pay check worth more to him and his family.

The worker must learn that the slowdown brings inflation and that the speedup will stop it. He must learn that the slowdown at work brings poverty and misery, while the return to normal production brings abundance and happiness for all. He must learn that the important thing is not the dollar—but what the dollar will buy. The high standard of living in America was built by inventive brains and hard work. Strikes and slowdowns will kill it.

The auto workers who slow down on the job, also buy automobiles. When this worker does half the work for twice the pay, the labor cost in his new car is four times as much as it was before. If he slowed down to doing only one fourth the work for four times the pay, the labor cost in the car would be 16 times as much, and pretty soon the automobile business would shut down.

PRODUCTION COUNTS

In automobiles, in refrigerators, in washing machines—in every line—it is the same story. The carpenter who loafs on the job makes the house that his G.I. son buys cost more than his boy can afford. The plumber who doesn't want to work on Monday, but insists on 16 hours' pay for 8 hours' work on Saturday is building toward the day when he will live in a hovel in misery and poverty. Production is what really counts in any system.

A man, a family, a nation, gets rich by working, not loafing on the job. America was built by hard work. The great American standard of living was no miracle—it was the product of brains and hard work. The American people will live only as well as the average man does his work.

So you men of theory and practice, you men of brains and ability, you men who are building the mechanical age, get out in front and lead the way straight down the high road—the hard road—the right road toward freedom and abundance for all.

PRINCIPLES *of* ORGANIZATION

By EDGAR W. SMITH

VICE-PRESIDENT, GENERAL MOTORS OVERSEAS OPERATIONS

THE pursuit of a common goal by any group of two or more individuals involves, inevitably, the process of organization. That is to say, it involves the need for determining the task that each individual in the group will be called upon to perform, and the relationship that each such task will bear to every other task performed throughout the group.

We may search as long and as deeply as we will, but we shall find little more to the concept of organization than this. The sole purpose of the organization process is to enable men to work together with maximum effectiveness in the achievement of the ends they have in common. All of the problems that arise to confront an organization as it grows in magnitude and complexity are reducible, in the last analysis, to these simple fundamentals, and the technical terms so carefully chosen to express the principles deriving from these fundamentals are of significance only as they provide a frame of reference within which the problems themselves can be more conveniently and more intelligently approached.

TERMINOLOGY OF ORGANIZATION RATHER ABSTRUSE

The technicians have shown great ingenuity in identifying the principles inherent in the organization process, and, while the terminology they have adopted is sometimes abstruse, we cannot quarrel with the efforts they have made to give accurate and comprehensive definition to their meaning. They speak, for example, of the scalar principle, and the co-ordinative principle, and the functional principle. They speak also of the principle of line-and-staff; the principle of decentralized operations and responsibility with co-ordinated control; and the principle of the two-way flow of information and advice. These terms have very specific and definite meaning to those who have steeped themselves in the subject and who know just what it is the technicians are driving at. But unless we can relate them in our own minds to the fundamental purpose which the organization process is designed to serve, they will remain, for us at least, no more than the jargon of the specialist.

THE SCALAR PRINCIPLE

As a case in point, just what is meant by the scalar principle? Obviously, the organization process demands that the authority to determine who shall do what, and how it shall be done, must spring originally from the source of absolute power which gives the organization being, that is, the owners of a business, let us say, or the electorate of a democratic government, or the members of a political party or social club, or the established body of a church. But the exercise of this authority very quickly runs up against the barriers imposed by time and space and the limitations of the human mind itself; the people of a nation can no longer convene in popular assembly to make their laws and direct their affairs as the people of the New England towns did in Colonial times; the owners of any business that has passed the corner-grocery stage can no longer hope to perform all the functions that modern management entails. So as a first step in the process of organization, we find the beginning of a scalar chain in the creation of legislatures, boards of directors, governing committees, and general staffs, or whatever the appropriate form for the activity in question may be. These bodies possess the power of action, in areas specifically prescribed, as delegated to them by the source of their creation.

In the field of business enterprise, specifically, the board of directors uses this delegated authority to define the objectives the organization will seek, and to set the broad over-all course of its activity. Recognizing its own inability to handle the infinite detail for the proper execution of which it is responsible, the board passes along to others in turn, through the president or the general manager, the right to say who shall do what and how it shall be done. This process is repeated on down through the line of organization, with ever-diminishing powers inherited at each step in the scale, but with the responsibility as delegated carrying with it always a commensurate measure of authority to secure its proper discharge.

This passing on to others of the right to do the things that must be done is all there is, essentially, to what the technicians have termed the scalar principle in organization. When the enterprise is small and compact, the process is relatively simple; the head of the business has a full and detailed knowledge of all of its phases, he can look directly to his immediate subordinates for the help he needs, and the effectiveness of his personal authority is intensive and complete. As the group becomes larger, the process of progressive delegation becomes more complex: the manager is no longer capable of maintaining direct contact with the more remote elements of the activity, and delegations both of authority and responsibility become necessary in increasing measure. This necessity reaches its climax in the instance of the great modern corporation which seeks economic advantage for itself and the consumer through mass production and mass distribution, and which must, in consequence, expand to nation-wide or world-wide proportions. Here, with complexities and ramifications multiplied a thousandfold, the scalar principle finds its ultimate value in the preservation of every possible vestige of the informed and intimate control characteristic of the well-managed small business.

It is clearly essential, in the light of the definition of the organization process first provided, that each individual in a working group should know what his responsibilities are, and that he be given, by delegation, the authority which the discharge of those responsibilities requires. However, as our definition also suggests, the organization process has inherent in it something more than this scalar principle alone. It is not enough that a man should do his job understandingly and well, for the mere performance of a multiplicity of individual tasks carries with it no warranty that the objectives determined upon for the organization as a whole will thereby be achieved. It is implicit in the very nature of things, consequently, that the objectives to be sought shall be defined, at each descending level in the scale of organization, and that the individual efforts exerted throughout the group shall be so guided and controlled that the common purposes to which the organization is dedicated may be kept always in view.

THE CO-ORDINATIVE PRINCIPLE

The application of this guidance and control, the provision of a purposefulness of teamwork in the organization—of leadership, if you will—is what the technicians have termed the co-ordinative principle. It is the principle closest to the area of

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management itself and it involves by its very nature the establishment of policies, the development of plans, and the constant and vigilant use of every reasonable opportunity for results control.

Co-ordination can be effected in many ways. If the management is shortsighted and arbitrary—and there are cases, of course, where this is true—there can be a blind and arrogant dictatorship that gives no account to the fund of knowledge and experience available throughout the organization. A business enterprise, under our democratic form of government, is essentially an absolutism; that is to say, it is protected as all of us are as individuals, by the constitutional provisions which guarantee it freedom in the determination of its own internal affairs. In contrast to the status of management in a political dictatorship therefore the manager of a business enterprise in our democracy possesses the inalienable right to make all the mistakes he wants, and to run his business on the rocks if his stockholders will let him. This right of freedom of action, which is a very precious thing when it is not abused, includes the right of management to ignore the viewpoint of those who make up the body of the organization as a whole. However, if management approaches its responsibility for co-ordination wisely and well, it will recognize that a sound course of action can be determined upon only if the viewpoints of those who are intimately familiar with the different aspects of the business are given the weight they deserve.

However, all of this is beside the point of our immediate consideration. It is not essential to the organization process how co-ordination is effected; it is essential simply that it be effected. For it is obvious that, for better or for worse, there must be definition of purpose from the top if the relationship that each task bears to every other task is to be established, and if the forces at work throughout the organization are thereby to be dedicated to the common goal.

THE FUNCTIONAL PRINCIPLE

Utilization of the co-ordinative principle to this end demands as a fundamental condition that the many different types of activity to be harmonized and interrelated must be specifically determined and defined. Inevitably therefore the organization process involves what the experts familiarly call the functional principle, which is nothing more nor less than the setting of the pattern to be followed in securing an effective division of labor within the group. The need for setting this pattern is a thing separate and apart from the need for delegation of authority to the men who are chosen to work within it, although the two are closely relative in actual operations. We could say of the functional principle, in line with our original definition of the organization process, that it relates to the determination of the tasks to be performed by those individuals who, under the scalar principle, will eventually be called upon to perform them. It is the co-ordinative principle itself, of course, that lies over both of these concepts and ties the whole structure and process together.

If we accept the definition originally given to the organization process, it seems clear that the only principles really inherent and inevitable in it are the three we have so far discussed, namely, the scalar principle, the co-ordinative principle, and the functional principle. All of the things that a group of individuals working together to a common end are inescapably impelled to do, if their endeavors are to hold any promise of success at all, are embraced within the scope of the concepts these principles embody.

Nevertheless, there are other principles, too, beyond these principles fundamental in the organization process itself, which any group seeking to give its activity maximum effectiveness may well elect to follow. They are not organization principles, properly speaking, since the organization process can still go on, as it often does, without them. They are, in fact, principles of operation, for they provide the means by which the deeper principles involving delegation, co-ordination, and division of duties can be given better and more efficient application in the attainment of the objectives sought.

PRINCIPLE OF LINE AND STAFF

First in importance among these operating principles is the principle of line and staff, which is widely employed in the sphere of military organization, by the more highly integrated church groups, and among the larger industrial corporations. It can be discussed to best advantage, perhaps, if reference is made first to the operating obligations confronting the active head of any organized group, for it is the essential purpose of the line-and-staff principle to facilitate the discharge of these obligations.

If he is to administer his organization effectively, the general manager, to speak in terms of the business enterprise, must concern himself first of all with the problem of "what to do." He must then give thought to the problem of "how to get it done." Finally, he must take a look at what has happened and ask himself "how it came out." That is to say, he must concern himself with planning, with execution, and with results control. Everything he does, in the use he makes of the organization structure within which he works and in the application he gives to the principles inherent in the organization process, falls under one of these three heads.

In a small business, the manager will naturally do himself, and without reference to others, all of the planning and results control that may be called for. He may also do much of the actual job of execution, whether it requires simply waiting on the counter of his store, or working in his shop to turn out the product he sells to some wholesaler or jobber. But, as the business grows, the manager finds he needs help not merely on one, but on all of these counts with which he is concerned, and he must therefore cast about for ways and means to supplement his own capacities. It is here that the line-and-staff principle offers itself for use.

Under this principle the manager delegates to certain of his subordinates a large measure of responsibility and authority for the execution of those tasks which can be more effectively performed in the field or down closer to the actual point of operation. These subordinates constitute his organization of the "line." He also delegates to other subordinates a large measure of responsibility for planning and results control and for specialized assistance in helping the line to get its job done. These subordinates constitute his organization of the "staff." The authority and responsibility delegated to the line executives is usually for all functions of the business in a restricted geographic area or for a given line of products; the responsibility delegated to the staff officers is usually for a single function applicable to all products or all areas.

In its essence, the basis of the line-and-staff principle of operation is that the general manager may look to others for the doing of certain jobs he cannot do himself, and that he may look to others still for the help he needs in assuring that these jobs, and his own as well, are done with intelligence and with a view always to serving the over-all objectives of the enterprise. Possibly the simplest way of expressing the difference between the attributes of line and the attributes of staff is to say that, if the administrative head of an organization had sufficient time and sufficient capacity to study in detail and be thoroughly familiar with all phases of the work for which he is responsible, he would not need a staff. Therefore a staff organization can be looked upon as a group of men who, at the direction of the administrative head, study and analyze problems and develop

plans to the end that the administrative head may have before him the necessary facts and opinions upon which to base judgment and take action. A staff is, to put it very literally, something to lean on.

It may assist in an understanding of this operating principle to set forth briefly four cardinal points which go to define the place of line and staff, respectively, in the typical organization structure. These points may be summarized as follows:

1 Line and staff are jointly responsible for performance.

2 A line officer discharges his responsibility by taking direct action; a staff officer discharges his responsibility by furnishing information and advice.

3 Although staff executives are charged with responsibilities that have to do with internal administrative phases of the work in their own departments, this does not give them direct authority over the line forces in subordinate organization strata, nor does it relieve their line superiors of the basic responsibility for the results of their work.

4 Effective use by the line of the advice and assistance the staff can offer demands that the staff obtain and justify the line's confidence by creating for itself what we may call an "authority of ideas."

DECENTRALIZED OPERATIONS

We come now to the principle known as decentralized operations and responsibility with co-ordinated control, which is also an operating principle and not a principle of organization. It is, if you will, a philosophy of management designed to give the line-and-staff principle greater effectiveness. It means exactly what it says; instead of keeping the tightest possible hand on all operations at the central point of management, as is often done even in large corporations, and as can be done quite consistently, of course, under the line-and-staff principle itself, the men who are called upon to do their jobs down through the scale of organization are given the maximum degree of freedom in their actions consistent with the attainment of the over-all objectives sought.

Under this process of decentralization, the line officer is allowed to conduct his operations with the same degree of imagination and initiative he would display if he were in business for himself. Thus in the day-to-day conduct of his activity, he is able to anticipate that his work will be interfered with only in the event of some drastic shortcoming making itself apparent in the results he turns in. If such shortcomings become manifest, corrective action is, of course, necessary and to be expected; but with the business running in a generally satisfactory manner, this officer's line superior owes him the responsibility to respect the action he is taking, to give him the utmost support in what he does, and to accord him the maximum of credit for the results he achieves. No line superior who has a proper sense of his position can afford to interfere unduly with the work of his subordinates. The fact that he has made them his subordinates and delegated to them a large measure of his own authority implies a faith and trust in them that carry very definite attributes of responsibility. This sense of responsibility downward in the organization is essential to effective decentralization. Without it we cannot hope to capitalize adequately upon that intimate knowledge and contact on the ground upon which successful operation depends; nor can we hope to provide the incentive and the stimulation of initiative on the part of the individuals concerned that constitute the organization's driving force.

Co-ordinated control at the central point of management is necessary, on the other hand, to assure that the operations performed at all levels down the line are motivated by a common policy and dedicated to the achievement of the over-all goals for which the group is responsible. It is obvious that a sound course of management action can be determined upon only in the light of the knowledge possessed by men dealing directly with the problem; but it is also obvious that these men must be guided in turn by their understanding and acceptance of the purposes inherent in top-management policy. In its relation to the line-and-staff principle itself, the process of decentralization, as an element essential to the efficient conduct of the business at the point of actual operation, follows closely the projection of authority and responsibility to the line officers in the field or in the factory; the process of co-ordinated control, as an element essential to the establishment of uniform doctrine, is tied in closely with the responsibilities delegated to the staff executives in the central office.

The ability of the line executive to operate effectively, and of the staff to assist intelligently in the exercise of an intimate control over these operations, depends, of course, upon a close liaison and an unimpeded interchange of ideas, not only as between the staff and the central-office management, but also as between the staff and the various lines executives in the subordinate organization levels.

TWO-WAY FLOW OF INFORMATION AND ADVICE

The foregoing consideration relates to the principle, again an operating principle, of the two-way flow of information and advice. Unless he has ready access to the required sources of information; unless, when he has digested it, he can make his interpretations quickly available both upward and downward in the organization, the staff officer's capacities will never be adequately exercised. Nor will the line itself attain its maximum effectiveness if it is insulated against either the receiving or the giving of the information and knowledge required throughout the organization as a whole. The two-way flow of information and advice is essential to the establishment of common policy and common doctrine; without it the staff will be ineffective, and the line itself, in proportion to its very strength, may carry within it the seeds of cross-purpose and disintegration.

Organization is the symbol of man's will to strive and to conquer. It has its origin in the fact of his own human limitations, and its enabling force is the extension and multiplication of his basic creative urge. Its elemental purpose is that each man shall do, for the common end and the common good, whatever best he can.

We read in the eighteenth chapter of Exodus that Jethro found his son-in-law Moses attempting single-handed to administer the law in Israel. Jethro listened when Moses told him of his purpose and then he said:

"The thing that thou doest is not good. Thou wilt surely wear away, both thou and this people that is with thee: for this thing is too heavy for thee; thou art not able to perform it thyself alone.

"Hearken now unto my voice, I will give thee counsel. . . Thou shalt teach them ordinances and laws, and shalt show them the way wherein they must walk, and the work that they must do.

"Moreover thou shalt provide out of all the people able men such as fear God, men of truth, hating covetousness, and place such over them, to be rulers of thousands and rulers of hundreds, rulers of fifties, and rulers of tens.

"And let them judge the people at all seasons: and it shall be that every great matter they shall bring unto thee, but every small matter they shall judge; so shall it be easier for thyself, and they shall bear the burden with thee."

I think Jethro long ago answered most of the questions that we ask ourselves today. He saw clearly the need that exists, when men join themselves together in a common effort, for a

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THE NEED *for* SCIENCE LEGISLATION *by the* NEXT CONGRESS[1]

By W. RUPERT MACLAURIN

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

IN JULY, 1945, Dr. Vannevar Bush published a report to the President under the title "Science: The Endless Frontier,"[2] urging the passage of legislation which would create a National Research Foundation for the support of science.

The report was a reply to a letter from President Roosevelt in 1944, in which the President wrote:

> "Dear Dr. Bush: The Office of Scientific Research and Development, of which you are the Director, represents a unique experiment of teamwork and co-operation in co-ordinating scientific research and in applying existing scientific knowledge to the solution of the technical problems paramount in war. Its work has been conducted in the utmost secrecy and carried on without public recognition of any kind; but its tangible results can be found in the communiques coming in from the battlefronts all over the world. Some day the full story of its achievements can be told.
>
> "There is, however, no reason why the lessons to be found in this experiment cannot be profitably employed in times of peace. The information, the techniques, and the research experience developed by the Office of Scientific Research and Development and by the thousands of scientists in the universities and in private industry, should be used in the days of peace ahead for the improvement of the national health, the creation of new enterprises bringing new jobs, and the betterment of the national standard of living."

The President then asked Dr. Bush for specific recommendations as to what the government should do after the war for the support of science.

For assistance in forming a reply to this letter Dr. Bush asked the advice of a group of prominent scientists and engineers. A series of meetings was held and formal reports submitted which are included as appendixes to the Bush report. These reports constitute the most authoritative survey of American science and its postwar needs that has been made in this country.

FUNDAMENTAL SCIENTIFIC RESEARCH ESSENTIAL

It is significant that after careful study the scientists came to the unanimous conclusion that government support for *fundamental* scientific research in this country was essential. They felt, however, that there was no special need of government aid to applied research, engineering development, or applied engineering. Such work, they believed, was receiving adequate support from industry. But on fundamental research they concluded:

"The Committee has considered whether industry could or should assume most of the burden of support for fundamental research or whether adequate sources of support are in sight. The answer appears to be in the negative."

The danger that this group of scientists saw was that the tremendous stimulus given to research by the war would lead to an increased emphasis on applied research to the detriment of further advances in fundamental research. According to the Bush estimates, industry before the war devoted about 5 per cent of its research budget, or $9,000,000, and government about 15 per cent, or $7,500,000 to fundamental research. Colleges, universities, and endowed research institutes spent 70 per cent of their research budgets, or a total of nearly $23,000,000, in this way. In the decade from 1930 to 1940 applied research was expanding much more rapidly in the United States than fundamental research. The basic reason for this was that the universities were finding it increasingly difficult financially to expand their research programs to anything like the extent that they were capable of doing.

It was on the basis of these facts that Dr. Bush recommended to the President the establishment of a National Science Foundation, with a budget of approximately $100,000,000 a year. Bills were subsequently introduced in both houses of Congress embodying the main features of the Bush report. Differences of opinion on the fundamental issues rapidly developed, both among the scientists and among the legislators. A science bill, S1850, was finally passed through the Senate but failed of passage in the House. So far, therefore, the Bush recommendations have not been enacted in legislation. In the meantime, however, it has been essential for science to continue.

The Office of Naval Research of the United States Navy has come to the rescue and launched a program of fundamental scientific research which in its main features embodies many of the recommendations of the Bush report. The research areas covered include physics, chemistry, geology, mathematics, medical sciences, psychology, and other related fields. While there is no experience yet of research results under this new program, the methods which the Navy is following are generally regarded by scientists as exemplary.

The Army is also initiating a program of research on a large scale, in co-operation with the universities, but its program is emphasizing applied research more directly.

Although the way in which the Navy and the Army are approaching the problem of supporting scientific research in the universities is distinctly encouraging, it does seem unfortunate that the support for fundamental science should come almost exclusively from the armed services. There are a number of dangers inherent in this situation. The first is the likelihood of diverting too large a proportion of our scientific talent into channels which are related to military weapons. Even where, as in the Navy contract, the emphasis is on fundamental research without restrictions, scientists working under contracts

[1] One of a series of reviews of current economic literature affecting engineering prepared by members of the Department of Economics and Social Science, Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] A review of "Science: The Endless Frontier," a report to the President on a program for postwar scientific research, by Vannevar Bush, Director of O.S.R.D.

with the armed services will inevitably feel some obligation to direct their attention to possible military applications. Moreover, many fields—such, for example, as astrophysics—are sufficiently remote from military objectives so that the armed forces are not likely to support them. There is, finally, the danger that in future "economy drives" the Army and the Navy will be forced to drop their longer-range scientific research in favor of activities which appear to offer more immediate results.

My own belief is that the support of science is so important to the country that it should be handled by a separate agency responsible directly to Congress. As this question is almost certain to be considered by the new Congress, it should be helpful to review some of the major issues that are likely to be debated and that caused so much controversy in the previous legislative proposals.

THE PROBLEM OF POLITICAL CONTROL

The first of these is the question of the administrative organization to direct a National Science Foundation, if that is to be established. The scientists of the Bush Committee were quite properly concerned with the problem of political control. They felt that the dangers could be minimized by leaving the top administration to a board of private citizens to be appointed by the President, They hoped that these men would be largely scientists, and would act as a buffer to protect the organization from the pulling and hauling of pressure groups. The board in turn would appoint a director who would be responsible to them. As opposed to this, Senator Kilgore and the White House administration interested in science legislation strongly favored delegating the task to a single director responsible to the President, who could have an advisory board, but would not be responsible to it.

As an administrative procedure, the board method has worked effectively in the private science foundations, such as the Rockefeller Foundation and the Carnegie Corporation. On the other hand, it may not be appropriate to our particular method of government. There are many congressmen who feel that Congress should not delegate authority for the expenditures of funds to people who are not on government payrolls. There is something to the charge that scientists would like to obtain funds from Congress but are not willing to pay the price of doing so. It is also clear that the present method under which universities are accepting large sums of money from the armed forces is actually submitting the universities to administration by governmental officials. So far this has not proved particularly damaging, because the universities do not need to accept research contracts and are in fact doing some collective bargaining with the Army and the Navy in which they state that they will not accept contracts which do not conform to certain specifications suitable to the universities themselves.

Therefore, while my own personal preference would be for a board of civilians to whom a director would be responsible, I think it would be unfortunate if the entire legislation was held up by quarrelling over this particular issue.

RULES FOR DISTRIBUTION OF FUNDS

Another thorny question concerns the rules for the distribution of funds. S1850, which passed the Senate in the last Congress, called for the automatic allocation of a portion of the funds to land-grant colleges and tax-supported universities. This kind of question seems bound to come up whenever proposals are made for the government support of science. The opponents of the clause favored widespread distribution of funds to assist in building up institutions which showed genuine research promise but wanted to give the Board discretion as to how this should be done.

The fact is, of course, that at the present time fundamental scientific research is highly concentrated in seven or eight of the leading universities throughout the United States. It is also true that the policies of the large philanthropic foundations and of the O.S.R.D., the Army, and the Navy have tended to perpetuate this situation. A university has to reach a certain size and financial standing before it can afford a long-range research program. Once it becomes a center for such activity, it attracts the best graduate students in the country and adds materially to its capacity to conduct further research. This in turn leads to additional funds being placed at its disposal. And from this standpoint, any agency concerned with getting research results is far more likely to get full value for its money by spending it in the established research institutions.

Whether the level of research practice can be raised most effectively by a provision that requires automatic distribution of a portion of the funds to tax-supported institutions or leaving the matter to the Board or to the director, is hard to determine. My own preference would be to leave the question to the National Science Board, with a statement in the legislation that the Board will be expected to strengthen research in regions where there are not today recognized centers. I would then think that normal political pressures could be counted on to accomplish the geographical distribution that is needed.

THE QUESTION OF PATENTS

A further and even more controversial matter is the question of patents. It might be thought at first sight that, if the program were confined to fundamental research, the patent issue would not be important. As fundamental research is directed at discovering new properties of nature, it does not, in the normal course of events, lead to patents. A property of nature is not patentable. Moreover, there are large fields of fundamental research in mathematics, astronomy, geology, biology, and physiology, for example, where there are no patents. It is also true that typically the fundamental research worker is not interested in patents. Many government officials therefore have been taking the view that the government should maintain all patent rights arising from research which it has financed.

Let us consider what might be the implications of this policy. If a large proportion of our fundamental research in this country is to be carried out by universities with government funds, and if there is to be a strenuous effort made by government agencies supporting research to take out patents on the results, this will shift the balance of patent power from industry to government. If the government policy is to be one of granting licenses to all applicants at nominal royalty rates, this would greatly weaken present patent incentives. The vital issue is whether we want to maintain a strong patent system because of the stimulus that this provides to industry to invest in research and development. I for one should like to see certain changes made in the patent system; but I should prefer to see them occur as the result of direct legislative action. And I think it important for our enterprise economy to maintain strong patent incentives. I hope therefore that a formula can be devised which will protect the interests of the public and yet not emasculate the patent system.

SUPPORT TO THE SOCIAL SCIENCES

Finally there is the problem of support to the social sciences. I believe that problems of human relations are more important today than anything else and that one way to help solve

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ORGANIZATIONS *of* ENGINEERS *in the* UNITED STATES *of* AMERICA

By C. E. DAVIES

SECRETARY OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, NEW YORK, N. Y.

THE engineer in the United States of America is a vital factor in the life of his nation. He changes its economy and modifies the customs and social habits of its people. He is an idealist and a dreamer. He is a realist and a doer. He co-operates with his colleagues in technology but is impatient with politics. He is frequently charged with lack of understanding of the social effects of his work. He is modest of his talents and likes to be called to high places rather than aggressively press the crowd for position. This results in some places in an undervaluation of his services. He has the traits common to human beings, as is shown by the organization of his profession, but his work is good and he does have a high sense of professional responsibility.

It is my purpose to show how this engineer arranges his professional life. I propose to present a few statistics on the number of engineers, engineering students, and engineering organizations in the U. S. A.; to describe the normal process by which a young man becomes an engineer in my country; to say something about engineering as a profession; to outline the general pattern of professional responsibilities and the corresponding purposes of engineering societies; to touch briefly on the activities of such societies; and to show how engineering societies act jointly in matters of mutual and public interest.

In 1940, according to the Bureau of the Census figures, 245,700 persons in the United States of America or about one in 570 called themselves engineers. These persons participated in over 300 so-called engineering organizations, national, state, and local which, in 1945, spent over $3,000,000 in carrying out their activities. In 1940 also, 62,235, or about one-quarter of the total, were then licensed by 45 states to practice engineering within the states' borders. There are 133 educational institutions in the United States which have one or more accredited curricula and which grant degrees in 17 branches of engineering. It is estimated that in 1948 about 21,000 young people will be graduated with baccalaureate degrees in engineering.

THE PROCESS OF BECOMING AN ENGINEER

The larger percentage of those who call themselves engineers pass through a period of education in college or university, which is followed by a period of training on the job in a particular industry or specialty. Some time, at least a year, before graduation from the secondary school, the young man makes up his mind that he wants to be an engineer. He believes he has the qualities necessary for success in engineering, and, presumably, he likes mathematics, physics, and chemistry. So he enters an engineering school. The entrance requirements of these schools vary. If he enters a state-supported school in the state where he lives, the fact that he was graduated from a high school is generally sufficient qualification for entrance to the state university. Because of the rigid discipline in engineering curricula, however, he may be one of the 40 to 60 per cent dropped the first year. To enter the privately endowed schools which aim to reduce this high rate of mortality, he may be subjected to rigid tests for scholarship, aptitude, and personality before being accepted for entrance.

After four years or more of hard work he is graduated. If his bent is toward research, he may take a year or so of postgraduate work. Then he seeks employment. Because of the current shortage of engineers, he may have several offers from which to choose. However, he must meet the requirements of the employer. Large industrial concerns which employ the major portion of engineering graduates each year, subject the applicant to rigid oral examination for aptitude, personality, and such intangibles as latent leadership and promise of ability to advance in the employer's company. Employees of government undergo similar but less thorough examination.

After a period of job-training and experience that may vary from four to eight years, the engineer in training reaches a point where his judgment is matured, his experience is ripened, and his superiors decide that he may be given responsibility for an engineering job. At that point he attains recognition as an engineer. At that time, also, he may apply for legal registration to practice engineering.

THE PROFESSIONAL ENGINEER

Obviously, the true professional engineer maintains high standards of work and assumes the responsibilities of his profession.

There is a more limited concept of the "professional engineer" as the man who renders professional advice to his clients as distinguished from the engineer in the employ of industry or government. This concept lays stress on the intimate relationship of trust and confidence which exists between the engineer adviser and his client and assumes a high degree of skill and objectivity on the part of the adviser.

The legal concept of the "professional engineer" is established by law in three territories and forty-seven of the forty-eight states that make up the United States of America. These laws require that those qualified to practice engineering shall be registered, and others shall be prevented from practicing engineering or using any title or description tending to convey the impression that they are professional engineers. The laws of the various states differ in some respects but in general the purpose of registration is "safeguarding life, health, and property, and promoting the public welfare."

Most state laws define the professional engineer in some such terms as "a person who by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and practical experience, is qualified to practice engineering, as attested by his legal registration as professional engineer." The professional education mentioned is that obtained by graduation from an accredited curriculum or the equivalent. The practical experience requirement varies from state to state, the most frequent being four years.

Many state laws also define the practice of engineering as "any professional service or creative work requiring education,

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training, and experience and the application of special knowledge in the mathematical, physical, and engineering sciences to such professional services or creative work as consultation, investigation, evaluation, planning, design, and supervision of construction for the purpose of assuring compliance with specifications and design in connection with any public or private utilities, structures, buildings, machines, equipment, processes, works, or projects."

State boards of registration composed of qualified men are usually established to administer the laws. In most states, these boards are authorized to revoke the registration of any one found guilty of fraud in obtaining his registration or of gross negligence, incompetency, or misconduct in his practice. The number of registrations revoked is very small.

At the present time about 75,000 engineers are registered.

The National Council of State Boards of Engineering Examiners has been organized to assist the individual boards in more efficient and uniform administration of state registration laws. This Council operates a National Bureau of Engineering Registration established to facilitate the securing of interstate registration by engineers practicing in more than one state.

ORGANIZATIONS

Early in the life of the North American colonies, great interest was shown in new developments in science. Many groups with common interests in scientific phenomena or professional problems gathered into voluntary organizations for the interchange of opinion and experience. This community of interest was recognized legally during the first half of the nineteenth century by the passage of state laws permitting such scientific, educational, and cultural societies to become incorporated as nonprofit bodies.

Table 1 lists some of the organizations of engineers in the United States of America and other national bodies which have some relationship with engineering.

TABLE 1 SOME ENGINEERING ORGANIZATIONS IN THE UNITED STATES

Date organized	Name	Number of members
1848	Boston Society of Civil Engineers	695
1852	American Society of Civil Engineers	21475
1857	American Institute of Architects	3100
1869	Western Society of Engineers	1362
1871	American Institute of Mining and Metallurgical Engineers	13427
1876	American Chemical Society	42600
1880	The American Society of Mechanical Engineers	21063
1881	American Water Works Association	6068
1884	American Institute of Electrical Engineers	25829
1888	American Mathematical Society	2314
1891	American Railway Bridge and Building Association	547
1893	Society for the Promotion of Engineering Education (Recently, 1946, changed to American Society for Engineering Education)	4111
1893	Society of Naval Architects and Marine Engineers	4317
1894	American Society of Heating and Ventilating Engineers	4916
1894	American Public Works Association	1287
1896	American Foundrymen's Association	8900
1898	American Society for Testing Materials	5798
1899	American Railway Engineering Association	2267
1899	American Physical Society	3800
1904	Society of Automotive Engineers	14714
1904	American Society of Refrigerating Engineers	4500
1906	Illuminating Engineering Society	4947
1907	American Society of Agricultural Engineers	1557
1908	American Institute of Chemical Engineers	6300
1910	American Institute of Consulting Engineers	131
1912	Taylor Society (In 1936 became a part of the Society for the Advancement of Management)	
1912	The Institute of Radio Engineers	18000
1913	American Management Association	10000
1915	American Association of Engineers	5030
1916	Society of Motion Picture Engineers	2259
1917	Society of Industrial Engineers (In 1936 became a part of the Society for the Advancement of Management)	
1919	American Welding Society	7808
1920	American Society for Metals	19628
1921	American Society of Safety Engineers	5300
1932	American Society of Tool Engineers	18287
1932	Institute of Aeronautical Sciences, Inc.	6483
1934	National Society of Professional Engineers	13000
1934	American Society of Photogrammetry	1100
1936	Society for the Advancement of Management	5023
1938	Institute of Ceramic Engineers	389
1942	Society for Experimental Stress Analysis	1100

PROFESSIONAL RESPONSIBILITIES AND SOCIETY PURPOSES

The ideals of a profession must be in the minds and hearts of those who practice the profession. They cannot be imposed successfully by law or by any force or group outside the profession. Those who use the results of professional service can demand only wholehearted, honest, and efficient performance. States can punish only those guilty of fraud or negligence. If a profession fails in performance, it ceases to exist. If it fails in its ideals, it ceases to be a profession.

All engineering societies have been brought into being by ideals for advancement, for improvement, or for public service. An examination of these ideals as stated in the purposes of the various societies reveals a pattern of professional responsibility. These society purposes can be grouped into six primary responsibilities of the engineering profession.

First Responsibility of the Profession. To advance and extend engineering knowledge and art.

Related society purposes are as follows:

1 To advance the science and art of engineering.
2 To encourage original research.
3 To promote standardization of engineering specifications and methods of testing.
4 To maintain a library.
5 To confer honors and awards for outstanding work.

Second Responsibility of the Profession. To maintain high aims and standards for the education of those who are to become engineers.

Related society purposes are as follows:

1 To foster engineering education.
2 To foster among engineering students the study of philosophy and history, traditions and achievements, duties, and social functions of the engineering profession.
3 To encourage the personal and professional development of young engineers.

Third Responsibility of the Profession. To maintain high standards for entrance into the profession.

Related society purposes are as follows:

1 To aid in adoption of a high standard of attainment for granting the legal right to practice engineering.
2 To maintain high cultural and technical standards for admission to the society.

Fourth Responsibility of the Profession. To increase the usefulness of the engineering profession.

Related society purposes are as follows:

1 To co-operate with other engineering and technical societies.
2 To advance the unity of the profession.
3 To secure greater public understanding of the purposes of the profession.
4 To secure equitable compensation for engineering services.

Fifth Responsibility of the Profession. To maintain high standards of conduct between the engineer and his client, his employer, his colleagues, and the public.

Related Society purposes are as follows:

1 To maintain high standards of ethical conduct.

2 To maintain high professional standing.

3 To protect the public against unqualified engineering practice.

Sixth Responsibility of the Profession. To minister to the public interest.

Related society purposes are as follows:

1 To encourage a high standard of citizenship among engineers.

2 To encourage engineers to participate in public affairs.

3 To co-operate with governmental agencies on engineering matters.

4 To co-operate internationally on engineering matters.

Not all of the foregoing purposes are supported by all societies listed in Table 1. Many of them are advanced by joint bodies representing a number of societies as will be described later. Several societies limit their activities to one or a few of the stated purposes. The American Society for Engineering Education confines its activities to engineering education. The American Society for Testing Materials concentrates on standard specifications, methods of testing, and knowledge about engineering materials. The National Society of Professional Engineers, a federation of twenty-five state societies, omits purposes related to the "First Responsibility." Some societies concentrate entirely on the First Responsibility. Several of the older societies, in particular, the American Society of Civil Engineers, have well-balanced programs extending throughout the range of purposes listed.

SOCIETY ACTIVITIES

In carrying out these purposes, all societies hold meetings and issue publications. Some society meetings provide complete discussion of an entire field. At one four-day meeting of one national society recently, there were over 5000 in attendance, sixty-three sessions were held and 300 authors participated. Another society holds educational exhibits in connection with its meetings that draw thousands of engineers and technicians. Several of the larger societies hold four or more meetings a year in different parts of the country. The publications of the societies form an impressive collection of engineering literature that is noteworthy for its completeness, accuracy, and frank revelation of scientific information. Several societies publish over 1,000,000 words annually in their printed publications.

A number of the societies maintain extremely high professional standards of qualifications for membership. The National Society of Professional Engineers is open to those who are registered in one or more states to practice engineering. Other societies confer their higher grades of membership on those who have had a number of years of responsible charge of important engineering work.

Seven engineering societies provide for student members. While at school the student has first contact with his professional society and is able to proceed to higher grades as he gains in stature.

The larger area of the nation making difficult the attendance at meetings at a single central point and the importantce of contact between members led to the formation by several societies of local groups called "Sections" or "Branches" in those communities where sufficient engineering interest exists to provide for worth-while organizations. At the present time, the national engineering societies have from a few to 75 local sections in centers of engineering and industrial interest throughout the nation. These local sections hold meetings and co-operate with other local groups in engineering matters of local civic importance. To the young engineer, they provide an important contact with older men of professional stature and with the ideals and activities of groups of engineers.

The comprehensive plan of prizes, awards, and honors bestowed by the societies provides ample recognition of the meritorious contributions of engineers.

The importance of specialization in engineering is illustrated by the presence of the many specialized societies. The larger engineering societies also carry on specialized activities. The American Society of Civil Engineers has thirteen Technical Divisions; the American Institute of Mining and Metallurgical Engineers has six Professional Divisions; The American Society of Mechanical Engineers has nineteen Professional Divisions; the American Institute of Electrical Engineers has nineteen Technical Committees; and the Society of Automotive Engineers has eleven Professional Activity Committees.

PROFESSIONAL CO-OPERATION

Toward the end of the nineteenth century, engineer leaders saw the need for close co-operation between the engineering societies, and took steps to bring them together on problems of common import. The first joint activity was the establishment in 1902 of the John Fritz Medal, awarded each year for achievement in pure or applied science by the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. These four societies, known as the Founder Societies, thus commenced to work together and their joint influence has been powerful in advancing the profession of engineering.

In 1907, largely through the beneficence of Mr. Andrew Carnegie, the Engineering Societies Building was erected in New York. Three national societies and two local bodies now share the building with the Founder Societies which own and operate it. The building also houses the joint library of the Founder Societies. The building is now overcrowded and preliminary plans are being made for enlarged quarters for the present users and other national bodies that may be brought under one roof.

The Engineering Societies Library, as the combined library is known, contains approximately 174,000 items and provides service to engineers throughout the nation. Photostat copies of material in the library are furnished, books are loaned, searches and translations are prepared, and inquiries answered about particular technical problems. Located in the building near the Library, Engineering Index, Inc., prepares and publishes currently on cards, and annually in a bound book, an annotated index of the engineering literature of the world.

The importance of engineering research was recognized in 1915 by the establishment, through gifts of the late Ambrose Swasey, of The Engineering Foundation for the furtherance of research in science and engineering, and the advancement in any other manner of the profession of engineering and the good of mankind. Engineering Foundation is administered by the Founder Societies and, during 1945, its funds were devoted to studies in welding, soil mechanics and foundations, metal-cutting data, strength of metals, plastic flow of metals, and fluid dynamic problems in turbines and compressors.

Engineering societies which devote effort to standardization follow the procedures of the American Standards Association which was established in 1918 as the American Engineering Standards Committee. Standards of specification and dimension developed according to the procedures of the A.S.A. are called "American Standards."

Many engineering societies act as clearing houses to members who are seeking to employ engineers and members who seek opportunities for employment. For this purpose the Founder Societies have organized an independent nonprofit corporation, the Engineering Societies Personnel Service, Inc., which operates offices in New York, Detroit, Chicago, and San Francisco.

CO-OPERATION FOR PROFESSIONAL ADVANCEMENT

In 1932 the Founder Societies with the American Society for Engineering Education, the American Institute of Chemical Engineers, and the National Council of State Boards of Engineering Examiners, organized the Engineers' Council for Professional Development. The Engineering Institute of Canada became a participant in 1940. E.C.P.D., as the Council is now known, has as its aims the co-ordination and promotion of efforts toward higher professional standards of education and practice, greater solidarity of the profession, and greater effectiveness in dealing with technical, social, and economic problems.

It formulated the following program:

(*a*) To develop further means for the educational and vocational orientation of young men with respect to the responsibilities and opportunities of engineers, in order that only those may seek entrance to the profession who have the high quality, aptitude, and capacity which are required of its members.

(*b*) To formulate criteria for colleges of engineering which will insure to their graduates a sound educational foundation for the practice of engineering.

(*c*) To develop plans for the further personal and professional development of young engineering graduates, and also of those without formal scholastic training.

(*d*) To develop methods whereby those engineers who have met suitable standards may receive corresponding professional recognition.

While this program has been interrupted by the recent war, E.C.P.D. can report worth-while accomplishments, particularly in the completion of its program for accrediting engineering colleges. This is important because the granting of a license and the acceptance to membership in several of the societies depends upon graduation from an accredited school. The standards for the accrediting were established at a high level and administered painstakingly until the entire undergraduate engineering educational system was reviewed. The list of accredited curricula has been adopted for use by the principal engineering societies and the individual boards of state examiners.

As an effort to secure greater unity in the profession, an attempt is being made under the leadership of E.C.P.D. to develop a single Code of Ethics and Practice which all bodies might adopt.

JOINT AWARDS

In addition to the John Fritz Medal, there are the following four awards administered jointly by engineering societies.

The Hoover Medal. Awarded for outstanding civic or humanitarian activities.

Washington Award. Awarded for devoted, unselfish, and preeminent service in advancing human progress.

Guggenheim Medal. Awarded for notable achievement in the advancement of aeronautics.

Gantt Medal. Awarded for distinguished achievement in industrial management as a service to the community.

CO-OPERATION IN THE PUBLIC INTEREST

In 1920 the Federation of American Engineering Societies was formed "to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern to the engineering and allied technical professions." Three of the Founder Societies with other smaller national and a score of state and local bodies participated in this new agency. Later the name was changed to the American Engineering Council. In addition to assisting in the formulation of Federal legislation dealing with engineering problems the American Engineering Council conducted researches in "Waste in Industry," "Twelve-hour Shift in Industry," "Industrial Coal," "Civil Aviation," "Safety and Production," and "Street Traffic Signs." It also supervised a study on earnings of engineers carried on with the co-operation of the U. S. Department of Labor in 1936. Because of factors which may best be characterized here as differences of opinion, the American Engineering Council became inactive in 1940.

Some agency for dealing with problems of public importance being necessary, the Founder Societies in 1941 set up a Joint Conference Committee in which the American Institute of Chemical Engineers participated later. In 1944 the name was changed to Engineers Joint Council. This body was useful in many relations with the Federal Government during the war. Perhaps its most spectacular achievement was two reports, prepared at the request of the United States Departments of State and War, on the "Industrial Disarmament of Germany," and on the "Industrial Disarmament of Japan." Both reports have had important influence on policies adopted by the military governments of both countries.

The Engineers Joint Council is now engaged on the following program:

1 *Engineering Organization*. A comprehensive study of the needs of engineers for a national form of organization that will more properly serve the engineering profession in discharging its professional responsibilities.

2 *International Co-Operation*.

(*a*) Co-ordination of contacts and services in relations with engineers of other nations.

(*b*) General co-ordination of participation in the International Technical Congress and the Sixth International Congress of Applied Mechanics.

(*c*) Collection of engineering books and periodicals for the libraries of the war-devastated countries of the world.

(*d*) Engineering co-operation with the United Nations and with the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

3 *Aid in Federal Legislation*. On invitation, provide an engineering point of view to aid federal agencies and legislators in formulating legislation relating to engineering and scientific matters.

4 *Economic Status Survey*.

(*a*) A survey and report of earnings of engineers with relation to education, years in practice and field of specialization; the report to be completed about June 30, 1947.

(*b*) A survey of industry to determine company policies pertaining to the selection, training, placement, advancement, guidance, and professional activities of graduate engineer employees.

(*c*) A survey on the problem of "collective bargaining" as it affects or may affect engineers in professional work and in training for professional work. In 1935 the Congress of the United States adopted a law requiring collective bargaining in trade-union disputes, which made a distinction between management and employees. Many engineers, who, despite the fact that they render important confidential service to the management, do not have the responsibility to employ and discharge employees are therefore regarded as employees and therefore subject to collective bargaining. The Engineers Joint

Council, partly through a manual on collective bargaining, is preparing to provide guidance for such engineer employees.

CO-OPERATION IN THE COMMUNITY

One of the most important opportunities for co-operation among specialists in engineering is the opportunity which arises in nearly 100 engineering communities. Local sections and branches of national engineering societies have been mentioned. In addition there are many local engineering organizations of differing nature. These local organizations may serve a city, a county, or a state. They may be called clubs, societies, or councils. Some are social, others act as co-ordinating agencies to bring all of the local groups of engineers together on matters of common concern to the community. Some co-ordinate engineering meetings in the communities. In several cities, local engineering groups have their own buildings. The virility of these local organizations gives promise of providing a sound base on which to build a national organization and is receiving thorough consideration in the Engineers Joint Council study.

SUMMARY AND APPRAISAL

From the foregoing, it is now possible to summarize and appraise the manner to which the engineering profession is discharging its professional responsibilities.

To the outsider and possibly to the engineer himself, the organizations of the profession seem confusing. Because organizations of engineers to support their professional responsibilities are voluntary groups and reflect hopes, needs, and the individuality of specialists, they are essentially human organisms. Their patterns of purpose can be brought into national consistency only by discussion and persuasion. Because of natural human loyalties and associations, the organization of any new single society to provide an over-all agency has, in the past, resulted only in the addition of still another society to the confused scheme. Despite the failure of one national joint body, other national bodies are functioning satisfactorily and a large number of joint bodies are doing splendid work in the communities of the nation. To correct the present apparent confusion, several theories of over-all organization are being advanced by active protagonists. The Engineers Joint Council is making a painstaking study of the matter and in due course some alternative plans are to be presented for general consideration and decision.

The activities of the engineering societies and joint bodies that have been reported herein provide support for the professional responsibilities of the engineering profession. The sixth responsibility, i.e., that of "ministry to the public" has been the subject of public discussion. In certain very effective ways the engineering profession has contributed immeasurably to the public welfare. The daily work of the engineer results in plenty and convenience at less cost, but, in addition, the engineer has made his engineering skill available in such technical problems as safety and has developed codes and standards which have saved lives and money. Engineers are employed in large numbers by the public. The implication of this responsibility of "ministry to the public," however, is that, over and above his daily work, the engineer should assume some civic responsibilities and participate in public affairs, nationally and internationally. Several local engineering groups have made spectacular contributions to the solution of local civic problems. The Engineers Joint Council is busily engaged at the national and international level. During the war, engineers served in many capacities in public leadership in production and research, and the impact of science on statesmanship will undoubtedly call many to service in the future. Many engineers are active in their community problems by taking responsibility on local boards of education and boards of city management. However, there are few engineers occupying elective office. One practicing engineer is serving in the United States Congress.[1]

CONCLUSION

Engineering has been defined as "the art of organizing and directing men and controlling forces and materials of Nature for the benefit of the human race." The engineer's daily task is that of applying science in an economical manner to the needs of mankind. Engineering is a profession and the ideals that prompt a sense of professional responsibility will guide the man who enters it.

In the United States, the engineer has acquitted himself with distinction. He is meeting his professional responsibilities and may proudly proclaim his faith:

"I am an Engineer. In my profession I take deep pride, but without vain glory; to it I owe solemn obligations that I am eager to fulfill."

"When needed, my skill and knowledge shall be given without reservation for the public good. From special capacity springs the obligation to use it well in the service of humanity; and I accept the challenge that this implies."[2]

ACKNOWLEDGMENT

The preparation of a short objective discussion of engineering organization by an official of one organization presents some difficulty. Any success must be shared by many colleagues who have helped with the manuscript and with leaders of the profession whose writings are listed in the accompanying bibliography.

[1] The 80th Congress which convenes in January, 1947, has three members with an engineering backgroud.

[2] Quoted from "The Faith of the Engineer," approved by E.C.P.D. in 1943.

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ORGANIZATION *Requirements for Successful* EXPORT BUSINESS

By GEO. W. WOLF

PRESIDENT, UNITED STATES STEEL EXPORT COMPANY, NEW YORK, N. Y.

THE organization requirements for successful export business are no different as to fundamentals from those for any domestic business. However, since we are to consider the requirements for export, let us first take a careful look to see what foreign trade really involves.

PRINCIPLE OF TRADE BETWEEN NATIONS

Foreign trade is based upon one fundamental principle and a few indispensable conditions. The author will attempt to establish this one fundamental principle, in the following way:

The various regions and nations of the world are not equally favored by nature in potential wealth. The skill, proficiency, and aptitude for social organization and collective endeavors of their inhabitants differ widely.

Favorable climate, richness of soil, existence of minerals not found elsewhere, or their superiority in quality and concentration, adequacy of cheap and plentiful thermal or hydroelectric power, the fortunate location of resources with respect to each other and to the centers of production and consumption, facility of transportation, and other physical factors, render a region particularly adapted to the production of certain commodities.

On the side of human characteristics, marked proficiency of the labor of one country in special crafts, exceptional talents of its leaders for organization, management, and administration, healthy political environment, ability of its people, of all classes, to work together in a common effort for a common goal, are paramount elements in the determination of the fields of economic activity most appropriate for and most likely to be successful in that country.

The degree to which all those natural human as well as financial factors exist favorably and combine efficiently ultimately determines, for each area of the world, in what field of economic activity each nation can specialize to advantage. The fitness of a country to produce certain commodities or provide certain services is, in the end, evidenced by its ability to manufacture or supply them most cheaply.

Provided the exchange of goods and services is unhampered through the channels of international commerce and finance, the benefits that befall society through intelligently selected specialization of activities are immense. The volume of consumers' and producers' goods, which thus becomes available for the satisfaction of human wants, is vastly increased by the possibility of producing them where they can be supplied most economically, that is, in the largest quantity per unit of investment of labor, management, and capital.

The principle of specialization, however, should not be misconstrued as denying nations having no decided advantages in any field of production or service, any opportunity in participating in the productive cycles of the world.

From the point of view of the general welfare, it is desirable that a country devote its resources not only to the expansion of those enterprises for which it especially qualifies but confine these activities to lines where its comparative advantage in the cost of production is greatest. Reciprocally, unfavored nations should limit manufactures to those fields where comparative disadvantage is smallest.

However, it may be wise at times for a nation to foster in their infancy undertakings having eventual economic potentialities or encourage uneconomic activities vital to its defense or protection.

Peoples of nations poor in resources will produce less wealth with their efforts than the people of rich nations, but if they avail themselves of the opportunities of foreign trade, the volume of goods available to them through exchange will be far greater than if they attempt to produce all things.

No nation is self-sufficient. Policies aimed at promoting self-sufficiency through artificial restraints and barriers to volume importation of needed or desired commodities, is detrimental to a country's welfare. They remove labor, management, and capital from the fields of activity conducive to the best return to the nation, breed wasteful economic processes, and increase costs of production, thus lowering wages, profits, purchasing power, and finally living standards.

INDISPENSABLE CONDITIONS AS BASIS FOR FOREIGN TRADE

Now as to a few of the indispensable conditions as a basis for foreign trade:

Specialization is the necessary prerequisite of international commerce, but not sufficient unto itself.

To make the wheels of foreign trade turn, three other conditions must be respected: (1) The availability of the products to be exchanged abroad; (2) the possibility of settlement of international financial obligations resulting therefrom; and (3) the ability of the end-consumers in importing countries to pay for the products imported.

Specialization selects the types of industries which can be economically established in a country but does not determine the time at which these industries will actually begin to sell their wares abroad.

The point at which the real business of exportation will be initiated by the specialized industries is when a permanent excess of production over the domestic demand has been attained. Experience has indicated repeatedly that no industry looks for a stable export trade as long as the home requirements easily absorb output. Opportunistic export business, so common in the United States, contributes little firmness to the texture of international relations and is not worth considering.

The second condition establishes the ability of foreign importers to make payment in foreign exchange for the goods purchased without resorting to transfer of gold; it reaffirms the necessity of the maintenance of the balance of the international payments of the trading nations. It is of importance further to point out that continued imports of gold, in payment of exports of goods and services, react unfavorably on the economy

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of both the exporting and importing countries, weakening the financial structure of the nation deprived of gold and eventually increasing the price levels in the exporting nations taking payment in gold.

The last indispensable condition of foreign trade relates to the ability of the ultimate consumers in the foreign markets to buy the commodities and services exchanged. To prevent imported goods remaining unsold on the merchants' shelves and services unutilized, there must be sufficient purchasing power in local currency and an over-all availability of foreign exchange to permit remittances to the originating country.

The physical and human conditions which determine the superiority of a nation in the production of some commodities and services internationally traded, usually are not restricted within the boundaries of a single nation but cover larger areas of the world; hence with very few exceptions, of which diamonds is an outstanding one, competition remains open between a number of countries. Even when the production of a commodity is limited to a single nation, competition still exists between the various producers of that nation, unless the country is ruled by a regime of managed economy. So American manufacturers of steel, automobiles, electrical goods, etc., are highly competitive at home and abroad.

POSITION OF THE UNITED STATES IN FOREIGN TRADE

In the three-quarters of a century preceding the last war sweeping changes occurred in the picture of the business relations of the United States with the outside world.

Prior to the depression of 1873, a persistent excess of imports characterized our merchandise trade, which was counterbalanced by heavy investments of foreigners. After the 1873 crisis, an excess of exports appeared, limited in the beginning but progressively swelling into rivers of American goods for export during the early 20's and late 30's.

The character of our international trade also underwent striking change. Raw materials and foodstuffs, which previously constituted the main classes of our contribution to the international movements of goods, were gradually replaced by semimanufactured and manufactured articles. The importance of Europe as a recipient of our products rapidly declined, while the Americas, Asia, and to a lesser extent, Africa, imported more and more of our products. On the other side of the balance, our imports, which in the early days were principally composed of finished manufactures, progressively changed to crude materials and semimanufactures. Europe lost its outstanding sales position and the Americas, Asia, and again to a lesser extent, Africa, emerged as important suppliers of our needs.

But one factor in this picture must be recorded and wisely considered. The physical volume of our imports of foreign goods did not, over this same period, keep pace with the rhythm of our expanding economy.

The reason for this is not hard to discover; and though perfectly obvious has been completely overlooked, it is feared, and has led to much fallacious thinking and heaped much abuse upon America for not wanting to buy, but rather, and only, to sell, and sell, and sell.

Let us look at the facts.

Taking the year 1938, a good representative prewar year, 85 per cent of our imports by value were accounted for by only 100 items; 41 per cent of our total imports, for a value of $800,000,000 were duty-free. Items on which the duty was nominal accounted for 32 per cent of our imports for a value of $618,000,000. Thus 73 per cent of our imports, again by value, in a normal year are not seriously affected by duty.

So when we talk of increasing our importations by lowering tariffs, we are talking about approximately 30 per cent of our total normal imports. To double our total imports means increasing this 30 per cent area sixfold.

WORLD ECONOMIC LEADERSHIP

We, as a nation, have succeeded willy nilly to world economic leadership. The method by which we discharge this obligation will depend in no small measure upon our willingness to accept world leadership, especially in the spheres of international finance and service. One thing is certain, namely, that we cannot go on lending if we are not to be repaid. Unwise international loans enrich neither the one who gives nor the one who receives, and accelerates world misunderstandings that endanger world peace. Although loans of American money abroad may, at times, be essential to the over-all world economy, including our own, they are not a substitute for domestic imports of services as well as goods as providers of dollars; often they delay the solution of problems instead of facilitating it.

Contrary to a deeply rooted common belief, not less erroneous for being of widespread acceptance, imports are more beneficial to the economy of a nation than exports. After all, the final purpose of organized industry and commerce is to place at the disposal of man the largest possible amount of needed and desired economic goods. This optimum level in the enjoyment of wealth can be attained solely through imports of foreign commodities and services. The prosperity of a nation is not measured by its accumulation of precious metals and currencies, but by the essentialities and amenities of life available to its people. Exports are of importance inasmuch as they contribute to provide the means for the procurement of both.

Despite wishful expectations, many of our foreign loans, outstanding and planned, may never be refunded, because of the inability of the borrowers to honor their obligations. It is worth considering if, in some cases, it would not be preferable to extend financial assistance by purchasing abroad a larger amount of commodities of which we could make tangible use, rather than by swelling the account of our receivable foreign assets; especially so when our national resources begin to dwindle.

Some of the foregoing concepts have been consistently followed in our national policy of foreign trade; some others have been temporarily or permanently obscured.

ORGANIZING FOR EXPORT BUSINESS

Let us now consider those requirements of organization necessary for a successful export business, which after all is the subject at hand. It may seem trite to say that on the part of anyone organizing for export, there must be a full understanding of all the fundamentals affecting world trade, and a very particular and intimate knowledge of the special branch of export that is under consideration for entering or carrying on.

All too often, the objective or purpose of the organization is not well known or known to only a few. Let us examine by way of example, the objective of the author's company, which is as follows:

"To obtain as a minimum that share of all markets for the products sold, product by product, territory by territory, to which our capacity in relation to the industry as a whole entitles us, and, to accomplish this participation ratio through the exercise of judgment, so as to insure the maximum continuing return on investment to the corporation."

After one knows what he is trying to do, then, in the light of all the facts it is possible to obtain, the organizer must proceed—and again there is no intention to be trite—by taking the following steps in the order given: (1) Analyze, (2) organize, (3) deputize, and (4) supervise.

Whether it be organizing for export or for a domestic business, the steps are the same, and there are certain keystone principles of organization, which, if the resulting organization is to be sound, require careful adherence. These are (1) leadership, (2) delegation, and (3) function definitions.

"Leadership" represents authority. It must possess all the authority necessary to exercise its leadership. It must likewise possess all the attributes of intelligence, integrity, and capacity in sufficient degree to warrant the authority given to it.

"Delegation" is the center of all processes in formal organization. In essence, it involves a double responsibility. The one to whom authority is delegated is responsible to his superior for doing the job, but the superior remains responsible for getting the job done.

"Function definition" is the form in organization that assigns all functions, and is the organizational method through which leadership delegates to each subordinate his own specific task. Functions may be unlimited in number, according to the procedure necessary to attain the given purpose. Formal correlation of functions is the task of the "organizer." His job is to correlate duties as such. Correlation of spirit is the responsibility of the "leader." He correlates the people who perform these duties.

These facts show the importance of understanding the formal principles of organization. However, not until there is a general understanding of the common purpose can there be that real and horizontal correlation which is the final test of a truly efficient organization. It is the duty of leadership to attain complete correlation of functions.

Staff service in organization means the service of advice or counsel, as distinguished from the function of authority or command. This service has three phases, namely, the informative, the advisory, and the supervisory.

There are two prime requisites in efficient staff service, co-ordination and infiltration. The term "co-ordination" describes the necessary method of sound staff procedure, but "infiltration of knowledge" is the ultimate purpose of all staff activities. Staff service is not alone for the top leader. It comes to him first for he needs it in the making of his own decisions. But the subordinates also need it in the execution of their responsibilities.

It is not alone the leader who has important things to tell his subordinates. These subordinates likewise have important things to tell the leader—things he should know in the exercise of his leadership. Also, they have important things to tell each other. This mutuality of things to be made known runs through all relations of superiors, subordinates, and equals throughout the organization. The infiltration of the true service of knowledge cannot be conceived as merely moving from the top—downward. No organization can be truly unified in spirit until it has evolved a similar service moving from the bottom—upward. Only when all have the right to be heard through an organized machinery for the expression of such right, as a stimulus to its exercise, can there be a truly informed leadership.

SUMMARY

To summarize, top-management organization planning for successful export business involves the same principles and their careful application as does any other group effort Since export involves not only domestic considerations but world considerations also, export business, especially under present and foreseeable future conditions, involves many added complexities requiring an automatic organizational vigilance and intelligence for the detection, interpretation, and adaptation of organizational procedure and action, lest these ever-shifting "rules of the game" completely confound and frustrate one's efforts.

Today, all the world looks to America for credit, for materials, for know-how.

How long will the world sellers' market continue for the United States? How long should it? We cannot go on selling in endless volume if there is no prospect for a final balance in our international payments.

This gets down to each organization engaged in export business, having within its own organization the means for proper evaluation of the risks involved in doing international business in a topsy-turvy economical, political, and social world.

Principles of Organization

(Continued from page 18)

logically concerted approach to the achievement of their tasks. His dictum, as he laid it down to Moses, embraces the concept of the scalar principle, and the co-ordinative principle, and the functional principle. He pointed up the need for delegation, for indoctrination, and for the division of work. He suggested very pointedly the advantages of decentralized operations and responsibility with co-ordinated control. And he gave emphasis, finally, as we have come ourselves to do today, to the vital importance of the human factor in the organizational process. For no vehicle which is built in fulfillment of these principles we have discussed can take on life and reality unless it is put to intelligent and effective use in the interests of the human beings it is designed to serve. The concepts involved must be sympathetically regarded and practiced by all concerned; each individual must understand and accept his own responsibilities and authority and the responsibilities and authority of those with whom he works; the implications of subordination and discipline and dedication to over-all purpose must be rigidly adhered to. No structure that men create, however well devised, can be stronger than the men who compose it.

The Need for Science Legislation by the Next Congress

(Continued from page 20)

these problems is to undertake more research of a fundamental nature on the relations between people. I am sure that the scientific method can be applied to such problems with increasing effectiveness. The social sciences are not ready to spend research money on anything like the scale that it is being used in the natural sciences; but they do need more money for research than is now available to them.

A distinction should probably be made within the social sciences between those areas which are primarily concerned with "values" and those which are experimental and observational in character. A large proportion of the work currently in progress in psychology is experimental, and much of the work in economics, sociology, and anthropology is factual and analytical. Programs in these fields are now being supported by the Navy, and I see no reason why they should not be included in a National Science Foundation.

However, my personal belief is that legislation to support research in fundamental science is so important for our national well-being that scientists and engineers should compose their differences and unite behind a new science bill which will meet the major necessities of the case.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to original sources is given.

Gravity-Free Rockets

PREDICTIONS of new weapons for wars of tomorrow, and the possibility of constructing gravity-free rockets that will circle the earth in their own orbit are being made by Army Ordnance rocket and guided-missile experts, according to an interesting article by E. M. Rogers in the November-December, 1946, issue of *Army Ordnance*.

One of the most startling predictions concerns the man-made satellites that will circle the earth in their own orbit. Rockets that can strike any target on earth is another. Guided missiles that will circle the moon and take pictures of the side that is away from our eyes is still another forecast.

The atmosphere a few miles above the earth is almost unknown. Man has ascended about 14 miles in balloons. Free balloons carrying instruments have risen to 19 miles. V-2 rockets can reach up 120 miles. By replacing the explosive in the warhead of the V-2 with instruments, scientists can now learn more about the phenomena of outer space above the envelope of air that surrounds the earth.

One difficulty is that the rocket stays at its maximum height only a moment and then descends. Scientists would like their instruments to stay up longer. One solution is to make the rocket a satellite of the earth and have it stay up indefinitely. This is not as impractical as it appears. At heights of 200 miles or more there is so little air that its effect is negligible, and it can be assumed that an object could travel with no resistance. However, gravity would draw it back to earth if it were not traveling fast enough; but if it had sufficient speed, centrifugal force would counterbalance gravity, and the object would circle the earth just as the moon does.

Calculations show that if a rocket had a speed of 5 mps when it reached a height of 200 miles it would circle the earth indefinitely. This speed, five times greater than that of the V-2 rocket, is impossible to attain at present, but it will be possible within the next few years.

There are several problems to be solved. The rocket must travel slowly enough through the earth's air envelope to prevent it from burning up from friction just as meteors that glow and burn when they travel through the air at terrific speeds.

In order to climb, the rocket must accelerate constantly, but this acceleration can be kept within limits that would keep friction below the critical point. About fifty miles up, full power could be applied until maximum speed was reached. Then, traveling at a speed of 18,000 mph, or 5 mps, at an elevation of 200 miles, no more fuel would be needed and the rocket would constantly circle the earth at that speed in an orbit of its own, since there would be no friction to slow it down.

Outer space is supposed to be filled with cosmic debris and as the satellite swung along its orbit, there would be the ever-present danger of a collision. Unless it struck some object large enough to demolish it or cause it appreciably to lose its speed, however, the rocket would continue in its orbit. Modern telescopes are powerful enough to find such an object, and radar could be used to track it. Instruments could be carried that would send out a continuous stream of data on cosmic rays, magnetic storms from interstellar space, spores, charged particles of cosmic dust, or any other kind of particles or rays found in its path.

When Germany was captured, Ordnance Technical Intelligence teams found evidence that German scientists had been thinking about building space platforms that would circle the earth 5000 miles in the sky. No work that is known of had been done on the actual building of the platform, but elaborate plans had been made that are within possibility. The Germans had intended to mount huge sodium mirrors on these platforms that would focus the sun's rays on any portion of the earth and burn it to a crisp. However, this would be questionable since the envelope of air surrounding the earth would tend to dissipate the rays. In addition, the platforms would also be used to refuel space ships.

At a distance of 5000 miles from the earth's surface the pull of gravity would be greatly diminished; hence the centrifugal force needed to keep the platform there is less than at 200 miles. A speed of a little more than 3 mps would be required.

Since no large-scale experiments have ever been made on the behavior of materials at the temperatures that would be encountered in space, it would not be easy to construct a platform and to know that it would hang together. But bizarre as it seems, it is not impossible and someday may be accomplished if there is a need for it.

Army Ordnance officers want to emphasize that they are not attempting to make rockets that will reach the moon or circle it. Their sole interest is in building long-range military rockets. However, they do point out that their present experiments will allow scientists of civilian organizations to carry out such research.

Ordnance rocket and guided-missile research is designed to develop weapons that can be used to safeguard this country. Their goal is to develop a guided missile that can reach any target in any part of the world from the United States. This would require a missile with a range of approximately 13,000 miles. Paradoxically, they claim it would be more difficult to hit a target the size of a city, 13,000 miles away, than it would be to hit the moon which is 240,000 miles distant. On the last leg of its trip to the moon gravity would attract the rocket there, and, since the moon is 2000 miles in diameter it would be hard to miss.

On the other hand, a city 20 or 30 miles across is a very small target to hit at 13,000 miles or even at half that distance. Mathematically, the city would be more than five times as hard to hit as the moon.

Today, speeds of 3500 mph are reached regularly, and the present goal is about 17,500 mph. Thus no spot in the world will be more than 45 min away. It is terrifying to think that even if radar instruments should be able to pick up the launching of such a missile, there would be less than an hour to prepare any defense—if any defense were possible.

Antirocket missiles would have to be equipped with "hom-

ing" devices far more sensitive than any developed today. For one thing, the device would have to differentiate between meteors or other celestial bodies and the rocket it was seeking. Antirocket missiles would have to be faster than their targets, and, traveling at speeds more than 20,000 mph, they could not change direction readily. If they missed their target they would probably not have another opportunity.

One feature interesting to contemplate is a proving ground large enough to carry on experiments with long-range missiles. There are not many places in the world where there is an uninhabited range of even a thousand miles. Places like the Sahara and Gobi deserts are not uninhabited; there are roving tribes and travelers who might be hit by falling missiles. Central Australia offers possibilities, since it is probably the most sparsely inhabited region on earth.

Use of the oceans as proving grounds also offers difficulties in keeping shipping from the area and also in locating the terminal point of a flight. Perhaps the uninhabited regions of the Antarctic or the Arctic might make good firing ranges. This problem brings up another interesting speculation on the location of a permanent firing base.

A glance at the globe discloses that the majority of the land masses of the earth lie north of the equator. There are only a few important cities south of the equator. Located at the North Pole, a rocket-launching site could command most of the world with rockets of about 6000 miles' range. With an additional base at the South Pole, it would be relatively easy to dominate the entire globe.

One of the best solutions to the problem of fuel is the utilization of atomic power. Here is a relatively lightweight source of power that could take a rocket to its destination such as the moon and bring it back. On the other hand, a step rocket provides for only a one-way trip. To reach the moon, it has been calculated that a step rocket would require an initial weight of 250,000 lb.

In the spring of 1946 the Signal Corps bounced a radar signal off the moon and received it back several seconds later. To many this was a stunt that had little meaning. To scientists it was extremely significant. It showed that the Heaviside layer could be penetrated by radio waves and that the way was open for guided missiles that could be directed far beyond the surface of the earth. Radio messages could be sent back from the moon or other planets. If the radar signal had not been reflected from the moon, it would have indicated that the height of guided missiles would have been limited to that of the Heaviside layer.

We now know that satellite rockets could send back messages from out in space, and with atomic propulsion a near reality, the possibilities of this new type of weapon are limitless.

Business Contacts

AN editorial by G. F. Nordenholt, member A.S.M.E., editor, *Product Engineering*, in which he stresses the values of business contacts to design engineers, appears in the November, 1946, issue of *Product Engineering*. While Mr. Nordenholt's editorial is directed specifically toward design engineers, there is no reason why his concepts and suggestions cannot be applied to all types of engineers.

He writes that design engineers often complain that their work is too confining, that they do not have enough opportunities to meet people. Some engineers pride themselves on "sticking close to the job," who claim to keep abreast of progress solely by studying the engineering literature. They scorn outside business activities and associations.

Mr. Nordenholt points out that broad professional viewpoints can be obtained only by association and oral discussions with other engineers. The engineering professions, fully cognizant of the importance of close personal contacts among engineers, long ago organized societies to fulfill this very objective. Mechanical engineers have The American Society of Mechanical Engineers, the Machine Design Group of which was organized recently to meet the special needs of designers. A design engineer with a college degree or five years' experience in a mechanical-engineering job meets the professional requirement for junior membership. Local sections of the society hold frequent meetings in many cities. Thus the designer has numerous opportunities to meet other engineers at little expense.

There are innumerable benefits in addition to the knowledge gained from association with others. Viewpoints are broadened, self-confidence is built, personality is developed, and the individual learns to speak with conviction. Also, immediate economic benefits can be derived from meeting and getting acquainted with many engineers. When selecting men for promotion, the man with a host of friends has a distinct advantage. There is also the bald fact that the employer prefers to hire a man he knows or who is known to some of his friends.

The experiences of the large majority of engineers who have reached positions of high standing in their profession proves that participation in the activities of an engineering society through presentation of papers, serving on committees, or holding an elective office, multiplies manifoldly the chances for professional advancement.

Electrolytic Saw

A NEW way of cutting metal by a combination of electrical and mechanical action has been introduced at the Stalin works in the town of Gorki, Russia, according to a review, in the October, 1946, *Engineers' Digest*, of an article by K. Y. Skorniakov, which appeared in *Promisblennaya Energetika*, No. 1, January, 1946. It takes the place of circular-saw work and is particularly suitable for heat-treated steels, hard alloys, and thin tubes, but is also useful for ordinary sections.

Table 1 gives typical results showing that one electrolytic saw is able to do the work of several ordinary ones.

TABLE 1

Section	Number of cuts per hour: By circular saw	By electrolytic saw	Increase in production
1/28 in. × 1 in.	60	240	4-fold
1.2 in. diam	40	120	3-fold
0.8 in. diam	30	180	6-fold
1/2 in. × 1/4 in.	100	1500	15-fold

The construction is as follows: The cutting element is a smooth disk, 0.025 in. to 0.040 in. thick, the diameter of which, according to the sizes of metal to be cut, may be up to 12 in. It is mounted similarly to an ordinary saw but rotates at 2000 to 3000 rpm and is connected to the positive side of a dynamo. The metal to be cut is connected to the negative side and is insulated from the disk mountings.

A special electrolyte is pumped through a system of pipes to the point where cutting is to take place. The rotating disk is then pressed against the work by the action of a counterweight, and the electric current, in its passage from the work through the electrolyte to the disk, rapidly removes the metal by electrodynamic and electrochemical action.

The voltage required is 18 to 30 volts, and the current, according to size of section, varies from 50 to 100 amp. Thus a

direct-current welding set can be used to provide the necessary current.

This method can be employed on sections up to 2 in. thick. The speed of cutting varies greatly with thickness; with 1 3/4-in. thickness the feed is 1/2 in. per min; with 5/8-in. thickness, 12 in. per min; while 1/4-in. bronze can be cut at 28 in. per min. This illustrates to what extent the speed of cutting depends upon the current density.

Despite the heavy currents used, there is a net saving of power on the cutting operations which, in the case of the works in question, is estimated to be 140,000 kwhr per year effected by the use of two electrolytic saws.

Gas-Turbine Drive

A NEW application for the gas turbine, according to *The Brown Boveri Review*, December, 1945, is the drive of a 2500-kw steelworks blower, an order for which has been placed with Brown Boveri.

This steelworks blower set which produces the requisite blast for the converters will be operated with blast-furnace gas, or when this is lacking, with fuel oil. It is of very simple design, comprising air and gas compressors, air preheater, combustion chamber, and gas turbine. The same compressor provides both the blast for the converter and the combustion air. The space required by the set is very small, while it needs little attendance and upkeep. In contradistinction to steelworks blowers with steam-turbine drive the gas turbine can be started up within a few minutes. It needs neither boiler, feedwater, condensing plant, nor cooling water. Except for the relatively small starting motor no electrical energy is required. Moreover, on the score of heat consumption it is not inferior to a high-class steam installation. The governing of the gas turbine is also just as simple as in the case of the steam turbine. Because of its advantages it is to be anticipated that the gas turbine will arouse ever-increasing interest for the drive of blast-furnace and steelworks blowers.

Coal Drier

A TURBINE-TYPE German coal drier which may offer advantages of efficiency and economy to the American coal industry is described in a report (PB-28744) now on sale by the Office of Technical Services, Department of Commerce, Washington, D. C. With slight modification, the coal drier may be useful in drying chemicals.

The machine is designed to dry coal of small size, under 1 1/2 in. in diameter. It is 30 ft high and 15 ft in diameter and is said by the Germans to dry 50 to 60 tons per hr. Wet coal, poured in at the top, filters down through a series of slotted, rotating metal disks. The coal is dried by means of fans blowing heated air or gas over the disks. Power requirements are relatively low.

The makers of the German drier claim that no dust is lost in this process, and auxiliary apparatus for dust recovery is unnecessary. They also assert that the unit operates at maximum temperatures of 120 to 130 C when heated by steam, or 220 to 250 C when heated by combustion gases. These temperatures are believed to offer adequate security against accidental combustion of coal in the drier.

According to Chester A. Reed, member A.S.M.E., director of engineering, National Coal Association, the machine is efficient for its purpose, but requires modification before it can be used profitably on a large scale in the American coal industry. Europe's general fuel shortage necessitates maximum utilization of coal, including very small coal of high moisture content, but in this country such coal is usually discarded as waste.

However, Mr. Reed believes that the drier merits study by American chemical manufacturers, to whom high moisture content is a problem, as well as by coal processors.

Safety Electrode Holder

A SAFETY electrode holder for arc welding has been developed by The General Electric Company, Limited, Magnet House, Kingsway, London, W. C. 2, England, according to *Engineering*, Nov. 8, 1946. This safey device consists essentially of an isolating switch in the electrode holder itself. A sectional drawing, Fig. 1, illustrates its construction. The safety-type electrode holder is capable of carrying current up to 300 amp continuously and of operating with electrodes up to No. 4 S.W.G. As will be seen, it consists of a body of molded insulation *a*, terminating in a head of anodized aluminum alloy *b*, which is provided with cooling fins. The use of anodized aluminum for this purpose has two advantages: It prevents the accumulation of "spatter" on the radiating fins and provides a degree of insulation which minimizes random flashing due to accidental contact between the metallic part of the holder and the work. The electrode *c* is inserted in a nozzle at the extremity of the head *b*, and is gripped by a spring-loaded copper plunger *d*, which also acts as a conductor. The welding-cable socket is screwed and locked by a grub screw into the terminal block *e*. The inner ends of both the plunger and the terminal block are fitted with silver-faced contacts *f*, which are insulated from each other and are separated by a space of 3/4 in. Thus when not in use the whole of the exposed surfaces of the holder and electrode are insulated from the welding supply. The supply is connected to the electrode by depressing a spring-loaded lever *g* in the body of the holder. This operates a self-aligning silver-faced bridge piece *h*, which makes contact with the terminal block at one end and the copper plunger at the other. When the lever is released, a spring causes the bridge piece to break contact and make the holder dead.

Actual operating experience with the holder has led to the introduction of a number of features in its design. For instance, the entrance of foreign abrasive matter is prevented by an asbestos packing gland *i* in the tube through which the plunger passes. Friction is reduced by introducing a thin layer of graphite between the plunger and the tube. The spring *k*, operating the plunger is located toward the rear of the latter where the temperatures are comparatively low, so that the temper of the spring is not affected. As the holder can be dismantled in a few minutes without special tools the renewal of worn parts is facilitated. In addition to the cooling head *b* with its fins, there is a heat-insulating space between the body of the holder and the outer tube which is in contact with the operator's hand. This, it is stated insures cool operating

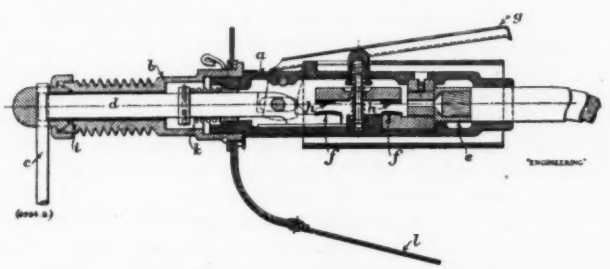


FIG. 1 SECTIONAL DRAWING OF SAFETY ELECTRODE HOLDER

conditions even when working at the maximum current. The back of the operator's hand is also protected from direct radiation from the arc by a nonignitable shield *l*, which can be detached when it is necessary to work in the less accessible positions. It may be added that the weight of the holder is only $1^1/_2$ lb and that the balance is improved by the use of a light alloy for the nosepiece. The pressure required to depress the switch lever is small.

The essential feature of the design is the contact system which was developed after extended tests under working conditions. It is claimed that the switch is capable of breaking the full welding current without severe arcing at the contacts, although normally, of course, it will not be required to do so since the current will be broken at the arc. In order to prevent the safety device from being put out of action deliberately, it has been designed so that electrodes can be withdrawn or inserted only when the switch is off. To replace an electrode the central plunger must first be retracted by an outward movement of the switch lever, and this cannot take place until the contacts have separated and isolated the holder and electrode. Thus an electrode can be replaced quickly and safely. Since the holder can be held comfortably without depressing the switch lever, an operator can gain access to work in confined spaces, keeping both electrode and holder dead until ready to strike the arc.

Man-Made Snow

A STUDY of ice crystals and "ice nuclei" has been under way in the General Electric Research Laboratory, Schenectady, N. Y., for some time for the purpose of investigating some of the basic problems related to the icing of aircraft and other cold-weather phenomena, according to an article by Vincent J. Schaefer of the Research Laboratory, appearing in *Science*, Nov. 15, 1946.

In the experiments conducted, a supercooled cloud is formed by introducing moist air into a small, commercial, freezing unit having a rectangular well 60 cm long, 45 cm wide, and 50 cm deep. In many instances it is possible to carry out the experiments with the top of the unit uncovered because of the stability of the cold air in the well. This forms a typical temperature inversion with the coldest part of the air at the bottom of the chamber. Under typical laboratory conditions with a temperature of 27 C, the temperature of the air in the center of the cold chamber is maintained at about minus 15 C, with the temperature minus 20 C at the bottom and minus 10 C near the top.

During more than a hundred experiments observed up to the present time, all supercooled clouds formed in the cold chamber have never developed into ice-crystal clouds except under conditions which will be described. Thus with all of the various types of dust particles normally present in a research laboratory, besides those which would be added by the proximity of many manufacturing processes, nothing served to initiate the crystallization of the supercooled cloud in the cold chamber. Under normal conditions in the chamber, the cloud persists for periods ranging from 4 to 10 min, the life of the cloud depending primarily on the evaporation and diffusion of the water droplets onto the ice-coated walls of the well.

In addition to permitting these various types of "commercial" dusts to enter the cold chamber, many experiments were conducted in which samples of various types of fine particles were intentionally added to the supercooled cloud. Carbon, graphite, oil, sulphur, magnesium oxide, volcanic dust, talc, silicates, silica, diatomaceous earth, and many others were introduced as aerosols in an attempt to force the supercooled droplets in the cloud to crystallize.

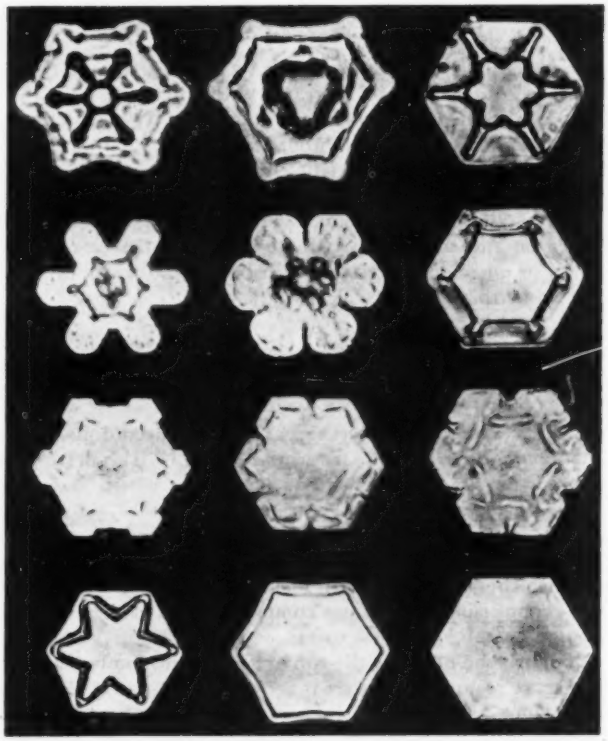


FIG. 2 CRYSTALS FORMED IN LABORATORY COLD CHAMBERS

By using a collimated beam of light from a 32-cp lamp in the cloud, the presence of a single ice crystal in the light path is easily observed. Water droplets in the size range of 5 to 20 microns, such as develop in the experiments described, scatter light mostly in a forward direction. At the same time, a typical water-droplet corona can be seen if the lamp housing is removed. An ice crystal, however, due to its crystalline angular faces, scintillates in the light as it tumbles about in the air and reflects light in all directions.

After undertaking many experiments in an attempt to form ice crystals in the supercooled cloud, a piece of solid carbon dioxide (dry ice) was placed in the chamber. Within less than 10 sec the supercooled cloud was completely converted to one of ice crystals! The introduction of additional water droplets to the cloud only served to make the ice crystals grow, since the vapor pressure of supercooled water is greater than ice. Replicas were made of the crystals formed in the cloud, and the microscope showed them to be similar to those found in Nature on cold mornings and known as "diamond dust." The crystals shown in Fig. 2 are representative of crystals developed in the laboratory cold chamber in about 4 min after a supercooled cloud was seeded.

Besides using dry ice as a source of ice nuclei, a rod cooled in liquid air and passed rapidly through the supercooled cloud leaves a trail containing great numbers of submicroscopic nuclei which, due to microturbulence, spread through the cloud, causing it to dry up as the ice crystals grow. Subsequent experiments show that myriads of ice nuclei form spontaneously if a copper rod having a temperature of minus 35 C is placed in a supercooled cloud having a temperature of minus 12 C. When replicas are made of the nuclei, which stream from the copper rod, they are found to have dimensions of less than 1 micron. Some of these tiny crystals show the trigonal symmetry of crystalline ice and are thin, triangular prisms.

An experiment to investigate various aspects of this spontaneous development of ice crystals in order to determine whether relationships can be established between the laboratory experiments and the natural atmosphere was conducted recently by G-E scientists while flying over Greylock Mountain, Mass.

As the airplane flew through the clouds, Mr. Schaefer dispensed 6 lb of small dry-ice pellets over a tract about 3 miles long. The cloud transformation was quick. Within a few minutes a radical modification of the cloud took place and streamers of snow began to pour out of the base of the cloud.

Though the cloud was of the stratus type, pillars of cumulus cloud began to rise from its top. The clouds which had not been seeded with dry ice had completely vanished about 15 min after the start of the experiment.

Reporting on his observations from the plane, Mr. Schaefer said that before he dropped the dry ice the cloud showed the typical irridescent effects and corona caused by water droplets, when he looked through it at the sun.

After seeding it with the pellets of dry ice, he flew below the cloud. He could easily see the snow crystals glinting in the sunlight, and there was a brilliant halo around the sun at a distance of 22 deg, an effect caused only by ice crystals.

Dr. Irving Langmuir, associate director of the Research Laboratory, cited several points which make these experiments significant.

First, they completely fulfill the predictions that clouds in nature, from which no snow is falling, contain no ice crystals but consist solely of water droplets, even at temperatures well below freezing. Once such a cloud is seeded with the solid carbon-dioxide pellets, which have temperatures of about 110 deg below zero, the water droplets are converted into ice.

FIG. 3 VINCENT SCHAEFER WAVES A SUPERCOOLED ROD THROUGH A SNOW CLOUD PRODUCED IN A COLD CHAMBER
(The cloud was created by introducing moist air from the breath into the minus 5 F temperature of atmosphere in the chamber.)

The heat which is generated by the freezing of the water produces turbulence in the cloud, which results in the pillars of cumulus that appear at the top. This turbulence enables the process to spread as a type of chain reaction and draws more moisture into the active region.

With a completely overcast sky, a single plane should be able to produce huge amounts of snow in comparison to the amount of carbon dioxide used. He estimated that a single pellet of dry ice, about the size of a pea, dropping 2000 ft through the air, might produce enough ice nuclei to develop several tons of snow.

In a five-hour flight a single plane could generate hundreds of millions of tons of snow over a large area. However, this would not necessarily mean a fall of more than a few inches of snow on the ground. There would have to be a continuing supply of moisture fed into the sky to produce a really heavy fall of snow.

It is believed that the method can be applied during the winter to produce snow in regions where there are clouds which fail to produce precipitation. Thus a supply of moisture could be stored up for the spring months, to feed irrigation and water-power projects.

Though modern airplanes can fly in the stratosphere, well above the clouds, they often have to fly through clouds of supercooled water which cause dangerous icing conditions. A single small airplane, using this method, could clear an area of such clouds.

Snow might be produced at mountain resorts for the benefit of skiers, and clouds which appear to be destined to produce snowfalls over urban areas could possibly be made to produce snow in other areas.

Crash Injury Research

THE Aircraft and Components Service, Department of Commerce, Civil Aeronautics Administration, following recent contacts with Hugh De Haven, Crash Injury Research, Cornell University Medical College, concerning crash protection, have arrived at the following interpretative material covering requirements of the subject, "Emergency Provisions—Protection:"

Cockpit arrangement and collapse of cabin structure have been found to cause excessive injuries in crashes. Close study of crash results show that the human body can tolerate crash forces which exceed those necessary to demolish contemporary aircraft structure. The following points are of general significance: (1) Many survivable accidents are "fatal" because of insufficient design consideration when mocking up the cabin and its installations; (2) the torso is rarely exposed to dangerous injury when the safety belts hold, and control wheels provide reasonable support for the chest; (3) fractures of the extremities occur in severe crashes but are not normally regarded as dangerous injuries; (4) head injuries are the principal cause of crash fatalities. Increased protection for the head can be provided by elimination, shielding, or redesigning of elements of the cabin which permit solid head blows in a crack-up, such as turnovers during a bad landing.

In view of the fact that injuries and fatalities in many moderate and severe accidents are purely mechanical results of poor cockpit design, the following guide rules for design are suggested: (1) Typical injurious objects, from the standpoint of crash injury, are listed as follows: (*a*) Those which present a hard surface and are so attached or have sufficient mass to produce a severe impact when struck by the head or other vulnerable part of the body as it swings forward under the specified inertia forces; and (*b*) those which present corners, knobs, or

similar projections which are likely to penetrate a vulnerable part of the body, even though the impact forces are not as high as in case (*a*). (A flat or curved sheet-metal panel which will dent upon impact by the head is not considered dangerous, whereas a magnetic compass case having appreciable mass and a rigid mounting might cause fatal head injuries.) (2) Heavy transverse braces or other structures immediately behind a light instrument panel have changed many accident reports from "Instrument panel depressed six inches by pilot's head" to "Fatal head injury; depressed fracture of the skull." Pilot's chances can be greatly improved by spacing solid braces several inches behind the ductile skirt of an instrument panel. (3) The solid tubing used as a back rest of the front seats of tandem aircraft is a setup for excessive head injury. The suggestion has been made that backs of forward seats be allowed to pivot forward so that the head of the occupant of the rearward seat would not contact the solid members when the body pivots about the belt. (4) Solid objects, projecting knobs, and sharp edges should be eliminated wherever possible within striking range of the head. (5) Panels should be smooth, with top edge curved in a substantial radius. (6) Apertures for instruments should preferably have beveled instead of sharp edges. (7) Special care should be taken to reduce the hazard of compass mountings, radio installations, and trim tab handles. (8) In personal aircraft, every consideration should be given to holding the body by adequate safety-belt installations, and by the support which can be provided in control wheels and instrument panels. The present "1000-lb" safety belts have failed in a high percentage of accidents without causing internal injuries or bruising of the hips. In failing, they have exposed the pilot to excessive injuries. (9) Control wheels should be designed to provide broad areas of support for the chest. Wheels which break under heavy loads from the hands or deform to permit contact between the chest and a small hub, localize force and set up chances of unnecessary chest injuries.

An article, "Mechanics of Injury Under Force Conditions," by Hugh De Haven, was published on pages 264–268 in the April, 1944, issue of MECHANICAL ENGINEERING, and an abstract "Aircraft Cabin Design" of an article by Mr. De Haven, published in the June, 1946, *Aeronautical Review*, appears on pages 824 and 825 of MECHANICAL ENGINEERING, September, 1946.

20-Million-Volt Betatron

A SIGNIFICANT advancement in the field of industrial radiographic inspection was marked recently by the unveiling of a 20-million-volt betatron at the Picatinny Arsenal, Dover, N. J. The new machine produces Roentgen (x rays) rays with power sufficient to penetrate 20 in. of steel in 20 min and to detect flaws of minute dimensions.

The production of x rays by means of a betatron was invented by Donald W. Kerst, physicist, University of Illinois, Urbana, Ill. The machine was built for the Picatinny Arsenal by the Allis-Chalmers Manufacturing Company as an inspection tool to check the loading of shells.

The great penetrating power of the betatron not only reduces appreciably the exposure time required for radiographs but also offers the industrial radiographer important advantages unknown to conventional x-ray machines. The betatron has almost absolute sensitivity in that it will reveal the same size flaw in a specimen regardless of the specimen thickness within the capacity of the machine. A 0.030-in. crack or cavity may be detected through 5 in. of steel just as clearly as through 18 in. of steel. Another advantage is the smaller focal spot of the

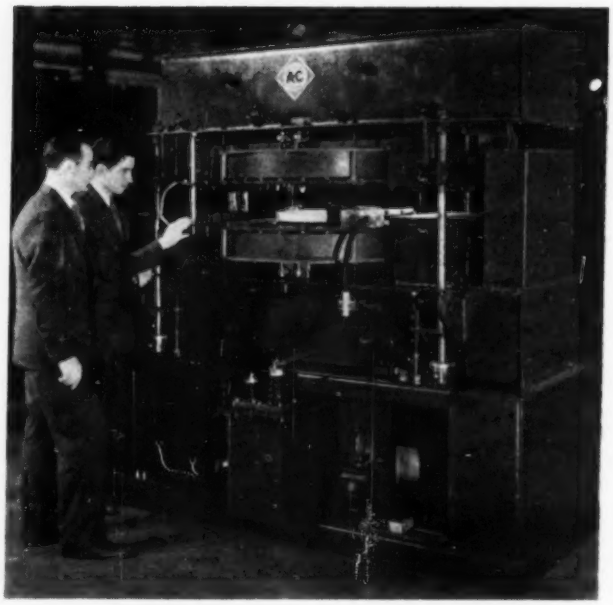


FIG. 4 TWENTY-MILLION-VOLT BETATRON

betatron Roentgen-ray beam. This makes possible a high order of definition of the radiograph. A sharp shadow is reproduced of those elements of the specimen which are remote from the film and interpretation of the radiograph is made easy. Direct enlargements are possible by placing the film at a distance behind the specimen. Because the major portion of the energy of radiation is confined to a cone-shaped beam, the problem of protecting personnel in the vicinity of the betatron is simplified. The machine may be operated by one person. The controls are simple and can be quickly mastered without extensive background experience in radiography.

The conventional method of producing x rays is by a high potential difference between the electron source and the target. The energy of the x rays produced is equivalent to the energy of the electrons at the moment they strike the target. Because of the problems of insulation at high potentials the maximum practicable energy achieved by conventional methods is in the neighborhood of four million volts.

The betatron operates in an entirely different manner. The instrument consists of an electromagnet, powered by an alternating current, and of a doughnut-shaped vacuum tube placed between the pole faces of the magnet. The operation of the betatron is analogous to that of an alternating-current transformer; the circular vacuum tube being in the same position as would be the secondary on a transformer.

During the quarter-cycle in which current flows through the primary, rising from zero to full value in one direction, the magnetic flux is also rising. In a transformer, the result is circulation of electrons in the coils of the secondary, the total voltage being proportional to the number of turns in this coil.

In the betatron, a supply of electrons is released inside the vacuum tube from a glowing filament and, under influence of the magnetic flux, spun around inside the doughnut-shaped tube. Through design of the magnet pole faces, the magnetic field is so shaped that it holds the electrons in a narrow path, or orbit, inside the tube. Though receiving only a relatively small amount of energy in each revolution, the total energy gained by the electrons in thousands of revolutions produces the high energy output of the betatron.

At the peak of the cycle, when the electrons have reached

their maximum energy, an auxiliary turn on the magnet is energized, upsetting the magnetic field and allowing the electrons to circle outward. They either strike a platinum target to produce x rays or through use of a "peeler" are brought out of the tube in a free beam.

The 20-million-volt betatron operates with a current alternating at a frequency of 180 cycles per sec. The electrons are accelerated in one $^1/_{720}$ sec, a quarter-cycle of each alternation. During that time, they spin around 350,000 times in the vacuum tube and travel a total distance of 250 miles, reaching a velocity of 186,000 miles per sec, just a fraction of a per cent below the speed of light. This is the greatest velocity ever produced by any machine. At each revolution the electrons gain up to 70 volts, although nowhere in the instrument is there any voltage greater than $^1/_{100}$ of the final energy. In producing this 20-million-volt output, the instrument uses a 25-kw power input.

The betatron is not to be confused with the cyclotron, another instrument for accelerating atomic particles to high energies. Aside from the fact that both work with atomic particles, the two instruments have little in common and, in fact, for certain research work, are complementary. They differ in what they do, what they do it with, how they do it, in size, and in many other respects.

The betatron works with electrons, the light satellite particles of the atom, while the cyclotron works with protons, the heavy nuclear parts of the atom. The two particles carry opposite electrical charges; the electron is negative and the proton positive. The proton also is 1800 times as heavy as an electron.

The cyclotron is an immense machine. The University of Illinois has a 10-million-volt cyclotron. It has a 60-ton magnet, wound with 10 tons of copper wire, and is mounted on a 37-ton concrete base. That makes a machine as big as a truck, and around it are ray-stopping water tanks with outside dimensions the size of a garage. The auxiliary equipment to operate the cyclotron is enough to fill another good-sized garage.

A 22-million-volt betatron, parent instrument of the commercial 20-million-volt betatron, has a $3^1/_2$-ton magnet, and weighs about 4 tons complete. It is 15 ft long and 3 ft high and has to be mounted on a pedestal to come up to convenient working height. The 10-million-volt cyclotron uses 150 kw of power for operation, and the 22-million-volt betatron, one fifth as much.

The way in which the two machines operate is as different as their sizes. The betatron uses alternating current, and the cyclotron direct current. The betatron operates by giving electrons one spinning push, like a self-starter spinning an engine faster and faster, until the electrons reach a speed very close to that of light. The cyclotron gives protons or deuterons repeated kicks as they circle in a spiral. The radio-frequency oscillator gives the particles a push twice in each revolution, and the final speed of cyclotron particles is about one tenth that of light. Energy output of the betatron can be easily changed while that of the cyclotron cannot. This close control is an important feature of the betatron for research purposes.

The cyclotron does have the advantage of a considerably larger beam. It is capable of producing intense artificial radioactivities, while the radioactivities produced around the betatron are very weak. However, the x-ray intensity from the betatron while it is running is great, and it is equivalent in ionizing power to the gamma rays from 3000 grams of radium—more than all the radium ever mined throughout the world. The most spectacular scientific possibilities of the betatron, however, lie in creating even greater energies than any yet produced. While 20 to 35 million volts is the optimum energy desirable for industrial or medical use, for scientific research energies far beyond that are needed. The University of Illinois is now building a betatron to have an output energy of more than 250 million volts. At this energy physicists should be within the field of cosmic-ray phenomena. They expect actually to produce cosmic-ray effects in the laboratory, and this will open entirely new doors to research. It will enable them to make fundamental studies which may provide clues to the nature of nuclear energy and nuclear forces, and actually to learn what holds the atom together. Production of mesotrons, those mysterious parts of cosmic-ray phenomena, is expected.

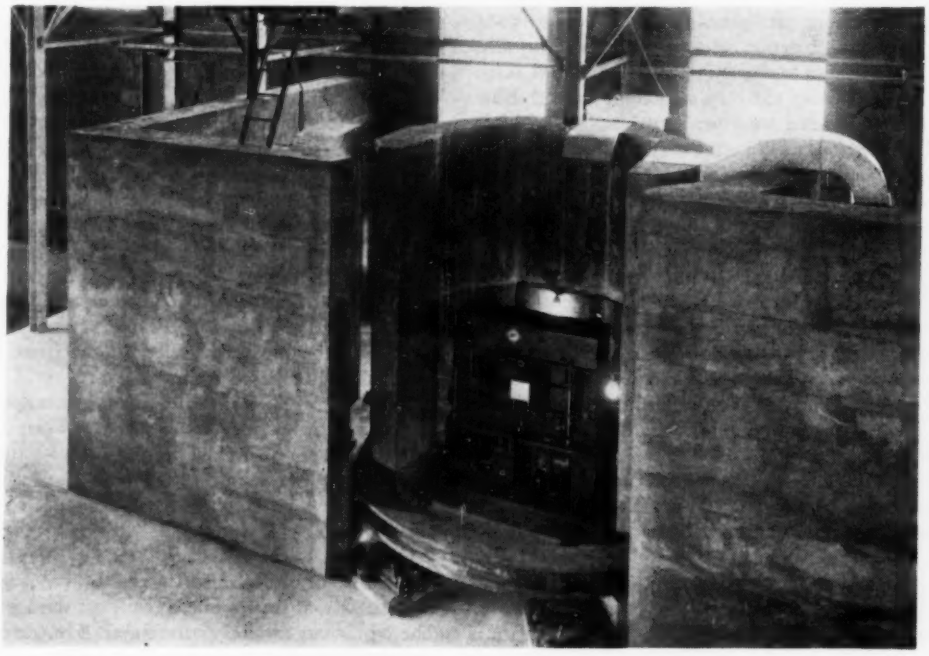


FIG. 5 INSTALLATION OF 20-MILLION-VOLT BETATRON SHOWING SHIELDING

Plastic Molding

A PARTIAL solution to the pressing problem of what to do with the existing wood-waste production is the use of wood-resin combinations in the manufacture of such items as furniture parts, many industrial accessories, and even sheathing board and other items for building construction, according to Robert A. Caughey, research director, Souhegan Mills, Wilton, N. H.

The methods that have been developed for this new field of plastic molding were described by Mr. Caughey at a Wood Industries session of the 1946 Fall Meeting of The American Society of Mechanical Engineers at the Hotel Statler, Boston, Mass. At the moment, he said, it appears that the most serious factor in this development is the capacity of the chemical industry for producing the resin-forming chemicals, but this difficulty can be eliminated fairly readily.

He also estimated that in terms of pounds of material, there is readily available at mills of the lumber and woodworking industries, and at low cost, wood waste in the amount of at least 80 per cent of the salable material produced in these mills. While a thoroughly sound material having all the properties of lumber except form, this waste has no extensive use other than as fuel. Since its heat value is low as compared with coal or oil, it is extremely bulky and a relatively small portion is sold for fuel or used by the woodworking plants themselves. Small amounts of selected types of wood waste are used for making wood flour and pulp.

The industry to which this waste situation presents the greatest challenge is the plastics industry. The wood in the form of waste is still sound material with its original basic properties of strength and chemical resistance. The only disadvantage of this material lies in its form, it being generally in such small pieces that it cannot be worked up into any usable product. It therefore remains to convert these small particles into large pieces of some practical value. It is apparent that, could the wood waste be so treated as to render it moldable, it would have application as a plastic for the fabrication of a wide range of articles having properties equal to, or better than, the properties of wood.

The obvious approach to the problem of utilizing wood waste as a plastic is first to reduce the waste to a uniformly finely divided form, then treating this ground material with active resins which will cause the resulting compound to flow and cure in the mold. Such a treatment, on the face of it, is nothing more than, or greatly different from, the usual preparation of a thermosetting molding compound. Therefore we arrive at a situation in which we have a raw material potentially available for the production of such an amount of thermosetting molding compound that the plastic industry, as we know it, could not even begin to absorb it.

During the war there developed a serious shortage of molding compounds, largely because of the diversion of resin-forming chemicals to munitions manufacture. As a result, a widespread interest developed in the conversion of the readily available wood waste into substitute molding compounds, or new types which would not require the same amounts or kinds of critical chemicals.

Mr. Caughey discussed several attempts which had been made in this direction but concluded that all of them were either limited in their applications or else too expensive for general use.

The following situation then prevails: (1) A large amount of wood waste must be disposed of; and (2) there is no available method for converting this material into a conventional type of molding compound, or a molding compound which can be handled on conventional equipment, at a price and with properties comparable with those of conventional molding compounds.

The logical approach to the problem is to attempt to use wood waste in the fabrication of products which have properties similar to those of lumber, rather than the properties of conventional molding compounds. However, since this application is almost certain to be more costly than the preparation of ordinary flat lumber it then becomes obvious that the field open for the application of such a material is that in which products are now fabricated from wood at great expense due to forming or milling operations, and in which plastics, as conventionally known, cannot compete because of the amount of material and size of product.

Mr. Caughey said such a product must have a density of from 20 to 60 lb per cu ft, must have reasonable impact, flexural, and compressive strength, must be capable of being formed into reasonably difficult shapes, and have sufficient chemical resistance for specific applications.

Recent developments have indicated that these conditions can be met with good success and using materials which are available in ample quantities. Most of the recent developments have been directed toward the use of sawdust and shavings without appreciable further reduction in size.

By the use of the proper amount and type of resin and by curing under proper conditions of temperature and pressure it is possible to obtain a molded product which has high resistance to water, high strength and hardness, and which is eminently suitable for a wide variety of applications.

It has even been found possible to produce molded boards from soft wood shavings at a price which can compete favorably with plywood or lumber in many instances. One good example is curved chair backs and other furniture parts in which high strength can be obtained easily without the attendant difficulties in plywood manufacture or in fabrication from solid wood.

Molded boards may also be veneered with ordinary wood veneer or may be faced with resin-impregnated paper sheets to produce such items as restaurant table tops. It has also been found possible to produce low-density boards, approximately 20 lb per cu ft, and $^{25}/_{32}$ in. thick, having properties superior to conventional pulpboard sheathing, and at a very competitive price. It has also been possible to extrude resin-sawdust mixtures for the production of such items as rolls and cores.

Airline Traffic

TWO revealing articles describing the ever-increasing air traffic and safety problems confronting the airlines appeared in the Oct. 19 and 26, 1946, issues of *The Saturday Evening Post*. The author, Wesley Price, a 15,000-hr man who has been an airline pilot for almost 20 years, predicts that "unless a miracle occurs—and nobody is expecting one—this winter should be the most bedeviled in the history of our swelling commercial airlines."

He tells how two of the top men of commercial aviation had an uncomfortable box seat to a preview last May 17 of the congestion that confronts the industry. With other outbound passengers they were stuck for hours on a ramp at LaGuardia Airport, New York, waiting for a chance to take off. Airline operators speak of this day as "Black Friday."

By 11:40 a.m on Black Friday thirty-two aircraft were stacked up or en route to LaGuardia. Air Traffic Control had no more room on its boards to post data on inbound flights. The work was too heavy for the staff in the control center. By the most optimistic estimate the last arrival, No. 32, would be stacked up and burning away its gasoline reserve for one and

one-half hours. That is, if landing intervals could be closed to three minutes; if no pilot missed his approach; if take-offs did not interfere—outbound airlines were clogging the taxi strip. It wasn't done that fast. It couldn't be done.

That was Black Friday—part of it. The traffic jam was bad all day long. The controllers kept the operations safe, but by nightfall airline men could count their losses; forty flights canceled outright; four diverted to other airports; an aggregate delay of 233 hours to planes stacked in the air or held on the ramp.

The airlines are having too many Black Fridays and Blue Mondays and Tough Tuesdays; too many canceled flights, delays, and missed schedules, says Mr. Price. An airline pilot reported that traffic tie-ups are costing them $25,000,000 annually. The pilot condemned our airway radio aids as obsolete, blamed Government red tape, and voiced the hope that instrument-landing systems, now being installed at key airports, would loosen the jam.

The Civil Aeronautics Administration admits that its instrument-landing system called ILS—is every bit as good as the pilot hopes for the next stage of airway development.

ILS has three parts: a radio glide path, radio marker beacons, and a little radio beam called a localizer. The localizer beam projects a narrow path of radio signals straight down the runway and out into the approach zone. If a pilot gets on this beam it will bring him right over the runway. But he might be far too high. This is where the glide path comes in. The glide path is another beam, slanting upward into the sky from the runway. If the pilot gets on the glide path, and controls his descent to stay on it, he will come to the end of the runway just high enough for a perfect landing.

To follow the localizer and glide path, the pilot watches a dial on his instrument panel. A vertical needle moves left or right if the pilot wanders from his heading. A horizontal needle creeps up or down if the pilot gets above or below the glide path. Then, when he gets near the airport, one of the radio marker beacons flashes a light in the cockpit. When he is 3500 ft from the runway a second beacon flashes another light. A third light flashes at the runway. That is ILS.

Others are in favor of another blind-landing system, ground control approach—a radar trick called GCA for short. All the controls are packed into a big truck which parks alongside the runway. Scanning devices on the truck's roof detect everything flying in the area. The aircraft appear on radarscopes as moving pips of light. Five men inside the truck watch the pips, locate the aircraft in space, and talk to the pilots on ordinary voice radio. They tell pilots what headings to fly, when to turn, when to descend. Finally, the ground controller gets the pilot lined up with the runway and talks him down.

The great difference between ILS and GCA is this: ILS puts all the responsibility in the cockpit; GCA puts most of the responsibility on the ground.

The placement of responsibility also involves the Civil Aeronautics Administration. If an accident occurred while CAA men were talking pilots down with GCA then the CAA might get most of the blame. With ILS, the pilot would be blamed. Critics of the CAA say that a reluctance to assume responsibility for tricky landings is the main reason that the CAA favors ILS.

The fact is that the CAA couldn't swap electrical horses right now even if it wanted to. The change-over from ILS to GCA might take three years to complete. The CAA would have to find radar equipment for 100 GCA trucks, possibly $20,000,000 worth, train 2000 men as GCA radar operators, and wedge into the budget $10,000,000 annually for their salaries. Moreover, any GCA bought now is apt to be obsolete soon. Already engineers are talking about a new model which two men can operate, instead of five.

The prospect of a three-year wait discourages the airline operators. They want ILS; they want the CAA to get on with its ILS program, and worry about GCA later. So the CAA is warming up instrument-landing systems at some fifty cities and is trying to equip another fifty before the bad weather just ahead. The CAA estimates that seventy nine will be in operation this month. Now it's up to the airlines to put ILS receivers in all planes and teach pilots to use them.

And still we shall have traffic jams, writes Mr. Price. Not just as bad as last year; worse. Extra flight schedules will be pouring into the tops of the stacks faster than ILS can pull them out of the bottom. By itself, neither ILS, GCA, nor any other blind-landing system can make airline timetables reliable in poor weather.

All sorts of schemes are being advanced; more airports, double runways on existing airports, different rules, brighter lights, a new holding pattern, automatic communications, and a dozen variations on radar. Some combination of these proposals will revolutionize air-traffic control, but not soon, the most cheerful estimate five years. Pessimists say ten.

High-Temperature Alloys

THE gas turbine needs metals that will stand high temperatures, and it is getting them. Focus of today's development in power generation, the gas turbine is driven by hot gases resulting from combustion. Its operating temperature is inevitably high, and its efficiency increases with higher temperatures. When intensive development of the gas turbine started in this country in 1940, operating temperatures were limited to about 1200 F, which, in a simple cycle, permits an efficiency of 23 per cent; today metals satisfactory up to 1500 F and 1600 F are available, and efficiency of better than 30 per cent is now possible.

In a gas turbine, the blades meet the most severe conditions and have received the most attention. At operating temperature, a red heat, they are so close to becoming plastic and are whirling so fast that "creep" (elongation because of the centrifugal force) becomes a vital problem, as does also corrosion because of the oxygen remaining in the hot gases.

Evaluation of materials for gas-turbine blades requires a complex balancing of all the factors involved, such as the stress imposed, the amount of creep permissible in view of the turbine's precise construction, the operating temperature, and the life expected. When wartime research started, the Navy set minimum standards calling for alloys which, operating at 1500 F, would have a life of at least 100 hr at a stress of 20,000 psi and a creep rate not exceeding one per cent in 100,000 hr at 7000 psi. These specifications called for an alloy essentially twice as good as the best which were available at the time.

Some of the high-temperature alloys developed for gas-turbine-blade use are reviewed in an article in *The Industrial Bulletin* of Arthur D. Little, Inc., for November, 1946.

One of the first good alloys to be applied was one which had long been used in dentistry and surgery. Known under the trademark "Vitallium," and composed of 65 per cent cobalt, 29 per cent chromium, and 6 per cent molybdenum, it is highly resistant to body acids and fluids, notably lactic acid. It also has good corrosion resistance at high temperatures, coupled with high load-carrying capacity, a trait not found in the corrosion-resistant alloys used for electrical heating elements. Vitallium was the alloy used for buckets in the aircraft turbosupercharger, which is driven by the hot exhaust and packs air into the aircraft engine.

Recent advances exceed the early Navy specifications by a factor of two from the viewpoint of stress permissible without undue creep, and by a factor of more than fifty as regards rupture life. One alloy, consisting of 20 per cent nickel, 21 chromium, 21 cobalt, and the remainder mostly iron, with smaller amounts of a number of other elements, will endure a stress of 15,000 psi at 1500 F without excessive creep. Modified vitallium compositions are estimated to be capable of lasting well over 7000 hr at the specified stress and temperature.

Since these and many others of the best high-temperature alloys cannot be forged or machined, they must be formed by the precision-casting method, taken over from the dental and jewelry trades, and widely used industrially during the war. An alloy of 60 per cent chromium, 25 molybdenum, and 15 iron is even stronger at 1600 F than some of the afore-mentioned compositions at 1500 F but is too difficult to produce commercially at present because of its high melting point. Forgeable alloys meeting somewhat less stringent requirements as to rupture life and creep are available for operation at 1500 F and can be used for the turbine rotors as well as the blades.

The cobalt-base alloys are stronger for short-time performance, whereas those containing approximately equal amounts of nickel, chromium, cobalt, and iron are better for long-time use, that is, greater than 10,000 hr. All the alloys require at least 20 per cent chromium for protection against corrosion and oxidation at high temperatures.

Wartime development has for the present eliminated metallurgical problems as the bottleneck in gas-turbine development; design and combustion problems are now the limiting factors. Operation at 1500 F and 1600 F has been indicated as feasible and tests show present alloys to be promising even up to 1800 F if stresses are reduced. Efficiencies up to 30 per cent have been demonstrated and promise to make the gas turbine an important contender in many large-scale power installations.

German Coal Usage

A PAPER in which he discussed the industrial use of coal in Germany was presented by H. A. Herder, fuel engineer, Sahara Coal Company, Chicago, Ill., at the 1946 Semi-Annual Meeting of The American Society of Mechanical Engineers held in Detroit, Mich. An abstract of the paper follows:

The industrial use of coal in Germany is predicated on the general economic condition of fuel that exists in that country. Germany has no petroleum and no natural gas, therefore coal is the primary source of fuel.

The coals mined in Germany are bituminous and brown coal, with a small amount of anthracite. The bituminous-coal production in 1938 was approximately 185 million metric tons, and the principal producing areas are: Aachen, Ruhr (including Krefeld), Silesia, Saxony, and Saar.

The brown-coal production in 1938 was approximately 190 million metric tons, coming from some twelve districts, the principal areas being Cologne, Kassel, and Silesia.

The area in Germany covered by Mr. Herder was all in the American, British, and French zones of occupation. In an effort to get a geographical coverage, plants were visited in Hanover, Kassel, Ruhr district, Cologne, Weisbaden, Frankfurt, Heidelberg, Mannheim, Stuttgart, Munich, Nuremberg, and the Saar Basin. Plants in Belgium and Holland were also visited.

The coal-burning equipment in German plants could be divided into three types: pulverized fuel, chain grates, and inclined grates.

PULVERIZED FUEL

Pulverized-fuel equipment was used quite generally in the electric generating stations, burning either bituminous or brown coal. These pulverizers were hammer-type mills, but quite often had fixed hammers instead of the swinging type. Most of the boiler units had a capacity of 150,000 to 200,000 lb of steam per hr. These units had either four or eight mills and burners per unit depending on the type of coal used. The furnaces were all waterwalled with dry bottoms very similar to those in the United States. Where brown coal was used it was quite evident from the flame that pulverization was not fine. In some of these cases the furnace bottom was inclined toward the center on about a 45-deg angle until the opening was about 4 ft square. Across this opening would be a set of water-tube grates to burn the larger particles that did not burn in suspension.

The bituminous coal burned in these generating plants was a type of coal that is not generally burned in this country. It is the reject from the cleaning plants, ranging in ash content as high as 40 per cent, with a top size of about $\frac{1}{4}$ in. This, of course, is a result of the general economies and conservation of the natural resources of the country.

Two modern pulverized-fuel-burning plants that could be described as the most advanced in Germany were inspected. One was a large electric generating plant at Essen in the Ruhr area, and the other was an I. G. Farben plant located in Southeastern Germany near Austria.

The coal-burning equipment, consisted of typical pulverizers and burners. There were eight burners per boiler, two sets tangentially in each corner of the furnace and near the base to give a scrubbing action on the waterwalls of the boiler. There were three pulverizers per boiler which fed into a common coal-distribution box to supply the eight burners per boiler. The furnace sides and bottoms were of hollow-tile construction and used for preheating air for coal drying at the pulverizers and feeders.

The steaming units were German-developed Benson boilers. Their efficiency was reported between 85 and 87 per cent. They were operated at a fixed load, and any power generated in excess of plant requirements was fed into the transmission lines.

CHAIN-GRATE STOKERS

Chain-grate stokers were found to be in use in most of the moderate-size industrial plants. These stokers were very similar to our chain-grate stokers. Every one that was inspected was forced-draft, and most of them were designed so they could burn coal of a wide range of quality.

Several of the chain-grate stokers had interesting variations of our general conception of such equipment. One of the industrial plants was equipped with three forced-draft chain-grate stokers under boilers of 250-hp capacity. These boilers, incidentally, were 4-pass water-tube boilers operated at 150 lb pressure. The stoker appeared typical in every respect except the links were fastened only at one end—the forward or carrying end. When the grate went around the rear end of the unit and came forward, the links came away from the frame and hung down in a vertical position. This was so designed to reduce obstruction of air passage, to assure clearing all ash from the links, and for better cooling of the metal. As the grate approached the front end of the stoker it passed across a roller which forced the links back into position to receive the fuel bed. These links were $\frac{5}{8}$ in. thick and 14 in. long.

Another interesting plant was located at a coal mine in the Saar.

The boilers were three-drum water-tube type designed to produce 55,000 lb of steam per hr at 200 lb pressure and 650 F final steam temperature. The boiler design provided for 5500 sq ft of heating surface, 2000 sq ft of superheater surface, and 9500 sq ft of economizer surface.

INCLINED GRATES

Inclined-grate stokers were used primarily at mine-site locations, burning brown coal or the sludge or slurry from the bituminous-coal-mine cleaning plants. The units burning brown coal were all quite similar, progressing from manual operation to fully automatic control. The manual natural-draft grates consisted of flat steel plates set horizontally across the furnace and stepped inward so the grate area was on a 20-deg incline. The more modern forced-draft stokers had well-designed reciprocating grates. The brown coal, being free burning, presented no problem on this type of equipment.

Refrigeration Laboratory

ARMY Air Force engineers now have a small replica of the North Pole, or at least the arctic conditions of the North Pole, neatly housed in buildings at Wright Field, Ohio, according to an article in *Refrigerating Engineering*, November, 1946

During the war, refrigeration tests at the Air Forces Test Branch of the Engineering Division's Equipment Laboratory at Wright Field enabled engineers to prove thoroughly the ability of military planes to perform satisfactorily at the frigid temperatures of high-altitude flight. Today the equipment and facilities for low-temperature testing have been expanded in this laboratory and engineers are busy conducting tests that will answer the many questions that arise in arctic flight, such as encountered in the current Operation Musk-Ox in Alaska.

The A.A.F. realizes that if another war must be fought, it will be fought over the Arctic and the refrigeration testing at Wright Field will be the hub of future Air Force development. The work is done in five test chambers under temperatures ranging from plus 160 F to minus 108 F.

The largest of these rooms, called the cold chamber, is one of the biggest refrigerators in the world. It is 83 ft long and 24 ft wide and it has a clearance of 25 ft—large enough for cold-weather tests on complete airplanes.

The chamber can be divided into two compartments with different temperatures in each, ranging from room ambient to minus 65 F. Refrigeration is produced by an ammonia system which has a capacity of 500,000 Btu per hr.

FIG. 6 A CO_2 FIRE EXTINGUISHER IS CHECKED IN THE ALL-WEATHER CHAMBER OF THE EQUIPMENT LABORATORY AT WRIGHT FIELD, OHIO. THE FIRE EXTINGUISHER WAS SUBJECTED TO A TEMPERATURE OF MINUS 85 F FOR 72 HOURS

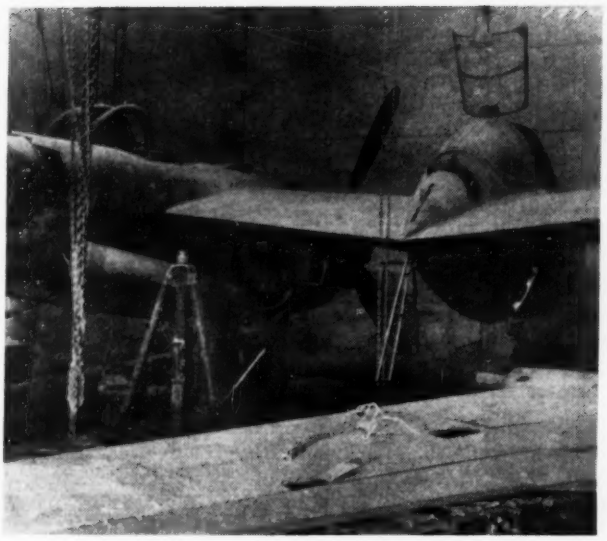


FIG. 7 COLD-WEATHER TESTING IN THE COLD CHAMBER OF THE EQUIPMENT LABORATORY

(Checks on a P-38 airplane are made on starting, oil dilution, exhaust pressure, cables, and instrumentation operation at low ambient temperatures.)

Climb and dive effects on aircraft parts are studied in a temperature-altitude chamber under environmental conditions, with temperatures ranging from plus 160 F to minus 93 F and simulated altitudes varying from sea level to approximately 53,000 ft.

The chamber is equipped with thermocouple connections, static line penetrations for checking pressure, and power lines for operating equipment under prescribed conditions. The hand-controlled, three-stage Freon-22 refrigeration system used to effect cooling is a prototype of refrigeration equipment coming into commercial use today.

Equipment, such as generators and alternators, is tested in an altitude chamber in temperatures ranging from room ambient to minus 108 F. In this chamber the driven speed of any test article is controlled automatically between 3000 and 4000 rpm by a variable speed installation.

An air-ramming system in the chamber duplicates the cooling effect of air on a plane during flight. The compartment also is equipped with thermocouples and power and static line connections. Instrumentation and visual observation through ports enable personnel to determine what happens to the equipment under simulated flight conditions. Findings may indicate to project engineers the need for redesign of certain aircraft equipment The chamber is refrigerated by an automatic three-stage Freon-22 system.

Ground equipment is tested in a sea-level chamber with a temperature range of plus 160 F to minus 90 F. In this compartment relative humidities of from 20 per cent to 100 per cent can be produced at temperatures from 40 F to 160 F. Rain up to six inches per hour also can be produced.

Certain types of aircraft equipment, such as gasoline pumps, are tested in an explosion-proof chamber. Equipped with all possible safety devices, this test compartment operates under controlled temperatures from minus 65 F to 40 F. Simulated altitudes range from sea level to 50,000 ft. A two-stage Freon-12 refrigeration system is used with this chamber.

A new laboratory now being equipped by the Test Branch

will duplicate weather conditions anywhere in the world. This laboratory will have a refrigerating system of 70-ton capacity, capable of producing temperatures from ambient to minus 112 F.

Liquid Helium

ENTIRELY new vistas in the field of science—such as confirmation of the existence of a new kind of sound, a so-called "second sound"—are being explored in the Sloane Physics Laboratory at Yale University, New Haven, Conn., through extensive experiments with liquid helium.

The research work in this field, and some of the findings, were made public for the first time recently by Dr. Cecil T. Lane, associate professor of physics.

Through the use of the liquid helium, it was revealed that temperatures within one hundredth of a degree of absolute zero, or approximately minus 273 C, have been reached, as compared with the lowest temperature ever recorded on the face of the earth—minus 68 C in Siberia.

So low are the temperatures that iron and steel, at these temperatures, are transformed into substances which shatter like glass. Should a technician dip his finger into the freezing material used by the laboratory, the flesh would take on the gloss and brittleness of glass, and the finger would shatter to pieces if struck against a desk.

The so-called second sound—the existence of which was confirmed through the experiments with liquid helium—is described as essentially a temperature wave. It was detected by measuring the transmission of a fluctuating temperature through the liquid helium.

Whereas the speed of the normal sound wave in liquid helium has been put at roughly 700 fps, it is ascertained that second sound travels through liquid helium at a rate of approximately only 70 fps.

Second sound is inaudible to the human ear, although well within the normal range of hearing, and has a tonal frequency corresponding to about middle C on the piano. The new type of wave apparently does not occur in any other liquid except helium. Another puzzling quality of second sound is that it ceases when the temperature of the helium rises above 2.2 C absolute.

The Yale laboratory has been concerned with merely the scientific aspects of liquid helium and low temperatures, and as yet has made no attempt at practical application. Although the practical uses of the research are entirely speculative, their scope covers many fields.

For example, it is possible that a new alloy may be compounded which would reduce electrical resistance to a negligible quantity. Such a development would expand the area of electrical power transmission far beyond present limits and save billions of dollars in the electrical industry.

Already other researchers have applied the same fundamental investigations to the development of delicate heat-measuring devices. This work foreshadows much more precise knowledge of astronomical bodies by means of measurements of the heat they give off. Thus a more accurate knowledge of space and the universe is possible.

Low temperatures permit the Yale investigators to make studies of materials which otherwise would be blanked out by the reactions occurring in the presence of heat.

The removal of heat in substances strips away a sort of mask and permits the scientist to study the material unhampered by interfering phenomena.

Experiments with liquid helium and a temperature of absolute zero hold the possibility of greater application of the fundamental theories behind all modern physical research.

These theories, the "quantum mechanics" concept of the make-up of the universe, are the groundwork out of which the atomic bomb was developed. Whereas this concept so far has been confined to the study of the atom, it is suggested that investigation of liquid helium may permit pushing the result of atomic research into the field of larger masses.

Confirmation of the existence of second sound is an example of the value of liquid helium in this respect. This use of liquid helium follows from the fact that it is apparently the only substance which obeys the principles of quantum mechanics.

Laboratory workers at Yale call helium a "magician's substance." A colorless watery liquid, it bubbles like a fine wine and gives off a "steam" when exposed to the air. One mysterious quality is displayed when an open beaker of liquid helium is suspended over another larger container of the substance. The helium in the upper container crawls up the side of the container and drops down into the lower vessel. The liquid shows an almost animal intelligence in seeking to join larger quantities of the same material.

Experiments have been conducted at Yale wherein containers of helium discharge into larger vessels, but never seem to empty. Measurements indicate that the smaller container will continue emptying itself for years. Thus the container of helium behaves like a bottomless, inexhaustible well.

Wire Tire Plies

TINY steel wires, 0.0059 in. thick, are going to help heavy-duty-tire users get additional puncture-free miles from their casings in the future. Already thousands of feet of steel wire are used in tires to provide a core for the bead which holds the tires on the rims. The new steel strands are being produced by the American Steel and Wire Company, U. S. Steel subsidiary, to form the plies or layers of materials which are saturated with rubber and form the inner core or body of the tire. Used extensively in heavy-duty tires during the war, the product proved to be of great value in providing longer life for casings and conserving critical rubber.

Three fine wires are twisted into a strand; six of these strands are laid around a central core to form a cord $^{1}/_{32}$ in. in diameter. A number of cords are then placed parallel to each other and coated with rubber, producing a ply of extreme strength and resistance for use in tire construction. When three or four of these plies are laid with the wires in each running at an angle to the wires in the other plies, a strong flexible foundation is afforded for application of the tread rubber. Four metallic plies are equivalent in strength and durability to approximately twenty fabric plies commonly used in heavy-duty tires. Although more rubber is necessary for one metallic ply than is needed to saturate one fabric ply, the over-all savings in rubber are of important proportions. At the same time, the metal sheath thus formed is highly resistant to punctures, bruises, and blowouts and the thinner structure provides greater resiliency and eliminates the creation of a large amount of heat, which is so destructive to rubber. The metal-core ply also eliminates casing stretch, which results in lowering of the density of the rubber contributing to excessive wear.

Due to the wrenching and bending to which the cords are subjected, the wire used in their production must be of an extremely high grade with tensile strengths ranging from 325,000 to 400,000 psi. The most rigid controls are exercised in the manufacture of the steel and in the subsequent drawing of the wire and forming of the cords.

To A.S.M.E. Members:

The Council Reports for 1946

THE first postwar year was one of increased tempo. With transportation restrictions removed and members released from service and war production, Society activities increased on all fronts. A single restriction—an acute shortage of paper—threatens to continue for some time to hamper Society work.

During the year the Society carried on its usual activities successfully. In addition, conspicuous contributions were made by engineers to important public problems, such as the disarmament of Japan, national research legislation, and the organization of the Atomic Energy Commission. Active participation was given in international problems. Nuclear energy and gas turbines had important places on meeting programs. The American Rocket Society became affiliated and is co-operating in program making. A Machine Design group was organized. The rush of students to engineering schools is intensifying the problem of the students and student-branch organization. An intensified program of standardization was started. The new scheme of vice-presidents with regional responsibility and authority shows first signs of success. The crowding of the Engineering Societies Building is being studied, but in the meantime the Society is obliged to use space in an adjoining building. The Secretary's staff has been built up more adequately to handle the load. Finances are in excellent condition and the number of members has reached a new high of 21,536.

PUBLIC SERVICE

Conspicuous and important public service was rendered by the engineers of the nation in the reports, prepared through the agency of Engineers Joint Council, on the disarmament of Germany and Japan. The recommendations of the German report had an important bearing on the directive of the Allied Control Council for the control of occupied Germany. The Japan report was completed in the spring of 1946 and received the enthusiastic endorsement of General MacArthur. The following excerpt from an editorial in the New York *Times* of June 15, 1946, points up the tremendous opportunity of the profession in matters of public import:

> One of the most striking things about the present report is nowhere to be found in it, able document though it is. This is the availability for national purposes of such organized entities as the engineering profession, whose technical competence is matched by their freedom from any suspicion of political motivation.

Services of similar orders of importance rendered during the year by Engineers Joint Council included: (1) The provision of competent engineers to advise the Senate on proposed legislation on research; and (2) the expression of engineering opinion that a division of engineering be included in the Atomic Energy Commission. The research legislation did not pass the Seventy-Ninth Congress, but the engineering division was provided in the Atomic Energy Commission.

INTERNATIONAL RELATIONS

Society activities at the international level were on the increase during the year. In 1945 the Society organized a Committee on International Relations whose function this year was turned over to Engineers Joint Council. Its work is mentioned more fully later in this report.

Progress continued toward agreement between Great Britain, Canada, and the United States on a series of standard screw threads. The principal point of difference, the angle of the thread, has been settled by the adoption of 60 degrees. Matters of gaging and tolerances are still under discussion. The A.S.M.E. Council voted to urge American industry to adopt the new standards.

Active co-operation is being continued with The Engineering Institute of Canada which participated in the 1945 Semi-Annual Meeting held at Detroit, Mich.

Two Chinese students have been awarded Freeman Scholarships for study in this country, in college and in industry, of the theory and practice of design, manufacture, and use of agricultural implements.

Stockholm has been selected as the place for the eighth in the series of International Management Congresses, in which this Society continues to play an important part.

The Society was ably represented at the Sixth International Congress for Applied Mechanics held in Paris, Sept. 22–29, 1946.

The International Technical Congress in Paris Sept. 16–21, 1946, brought together 1200 engineers from 30 nations to consider ways in which engineers may be increasingly useful in the major tasks of reconverting a war-torn world to peace and plenty.

ADVANCING MECHANICAL ENGINEERING

MEETINGS

Table 1 lists the Society and division meetings held during the year. The 71 sections held 556 meetings as compared to 527 in the previous year.

The 1945 Annual Meeting, with an attendance of over 4000, was featured by sessions on leadership and postwar research

TABLE 1 MEETINGS OF A.S.M.E. AND PROFESSIONAL DIVISIONS HELD DURING 1945–1946

Meeting	Number of sessions	Number of papers	Attendance
1945 Annual Meeting, Nov. 26–29, New York, N. Y.	62	170	3753
1946 Spring Meeting, April 1–3, Chattanooga, Tenn.	12	31	575
Aviation Division, June 3–6, Los Angeles, Calif.	20	54	1800
Oil and Gas Power Division, June 12–15, Milwaukee, Wis.	7	14	500
1946 Semi-Annual Meeting, June 17–20, Detroit, Mich.	36	83	1238
Applied Mechanics Division, June 21–22, Buffalo, N. Y.	4	17	159
Industrial Instruments and Regulators Division, September 16–18, Pittsburgh, Pa.	4	14	578
1946 Fall Meeting, September 30–October 3, Boston, Mass.	21	39	1293
Total	166	422	9896

problems. Honors were conferred as follows: Honorary Membership to Vice-Admiral Harold G. Bowen, Dugald C. Jackson, A. A. Potter, and Wong Wen-Hao; A.S.M.E. Medal to William F. Durand; Holley Medal to Sanford A. Moss; Worcester Reed Warner Medal to Joseph M. Juran; Melville Medal to William J. King; Junior Award to Bruce E. Del Mar; Charles T. Main Award to Jack Drandell; and Undergraduate Student Award to John W. Erickson.

The 1946 Semi-Annual Meeting was noteworthy for the discussion of the beneficent uses of nuclear energy and the presence on the program for the first time in the history of the Society of a member of the United States Senate, Brien McMahon, who discussed legislation for the control of atomic energy. Honorary Membership was conferred on William S. Knudsen.

During the year "The Public Responsibility of the Engineer" was selected as the guiding theme for Society meetings for the twelve months ending June, 1947.

A start was made to return to the peacetime basis of securing manuscripts sufficiently in advance of the meeting to permit preprinting and distributing technical papers for discussion and review.

This Society commemorated the achievements of George Westinghouse, past-president and honorary member of the Society, inventor, industrialist, and humanitarian, by a convocation of more than 60 scientists and engineers at the Engineers' Club, New York, N. Y., Feb. 26, 1946, on the occasion of the centennial year of his birth. The purpose was to call attention to George Westinghouse as the symbol of the engineer striving to improve human welfare and to the order of his genius and energy as inspiration for solving the industrial problems that confront the engineering profession today. President Yarnall presided, Dean Dexter S. Kimball, past-president and honorary member of the Society, was toastmaster, and the following addresses were delivered:

"George Westinghouse—The Man," S. W. Dudley
"George Westinghouse's Position in the History of Transportation," A. N. Williams
"George Westinghouse—The Individualist," F. D. Newbury.

PUBLICATIONS

During the year, attempts were made to effectuate plans to improve and expand the publications. The abstract section known as "Briefing the Record" was restored to MECHANICAL ENGINEERING and the A.S.M.E. News Section was improved and expanded. Improvements in appearance of publications have been prevented by the acute shortage of paper which has also necessitated a special student edition of MECHANICAL ENGINEERING without advertising pages, a reduction in number of student copies that can be printed, and a request to members to forego the privilege of receiving publications they do not need.

Release from war pressure and secrecy restrictions has resulted in an increase of papers submitted for publication and aggravated the problem caused by paper shortage.

The "Membership List" was issued in September.

A publication known as *Metal Cutting Data* was instituted on a subscription basis in July. This publication was instituted during the war under the sponsorship of the Manufacturing Engineering Committee by a contract with the Office of Production Research and Development.

The Metals Engineering Handbook, preliminary plans for which had been prepared by the Metals Engineering Division, was formally authorized as a Society project, an editorial board was appointed, and preliminary funds were allotted from the Development Fund.

A new journal, *Applied Mechanics Reviews*, was authorized during the year and preliminary plans were started for its publication. This journal, to occupy a similar place to that of the *Zentralblatt für Mechanik*, formerly published in Germany, is to be a review journal of the applied-mechanics literature of the world and will be published with the co-operation of interested societies and the Office of Naval Research.

PROFESSIONAL DIVISIONS

The 17 professional divisions made their usual strong contribution to the programs of the Society. The Industrial Instruments and Regulators Division joined the list of divisions which hold separate divisional meetings and the first venture, in Pittsburgh in September, was a splendid success. The Aviation Meeting in Los Angeles is established as a noteworthy annual event. Significant contributions to the Society's work are expected from the Machine Design Group which was formed during the year. Three divisions, Aviation, Materials Handling, and Wood Industries, celebrated their twenty-fifth anniversaries at the 1945 Annual Meeting.

The broad interest of several divisions in the subject of Gas Turbines led to the formation of a Gas Turbine Co-Ordinating Committee and the assignment to this committee of responsibility for seeing that Society members are kept informed of developments in this important new field.

A comprehensive manual for the organization and operations of professional divisions was completed during the year.

NUCLEAR ENERGY

A committee was formed early in the year to stimulate and develop a continuing program of Society activity dealing with the application of nuclear energy. This committee on nuclear-energy application contributed to the programs of the Chattanooga and Detroit meetings and recommended the formulation of standards, test codes, and safety codes for use in connection with nuclear-energy plants.

AMERICAN ROCKET SOCIETY

Affiliation of the American Rocket Society, approved early in the year, has resulted in active co-operation in joint meetings of the Rocket Society and divisions and sections of the A.S.M.E.

ENGINEERS' CIVIC RESPONSIBILITIES

The Committee on Engineers' Civic Responsibilities is having success as is evidenced by the time devoted to the subject by sections, by the papers in MECHANICAL ENGINEERING, and by the choice of "Public Responsibility of the Engineer" as a guiding theme for Society meetings.

STUDENT BRANCHES

The reactivation of the 120 student branches is proceeding in spite of difficulties arising from the large registration in engineering schools, the limited number of upperclassmen to assume leadership, and the heavy load on faculties. A total of 638 students from 64 colleges met in six group conferences; the honorary chairmen in two areas held meetings. It is confidently hoped that all the student conferences will be held during the next year.

SECTIONS

For a second year the A.S.M.E. Council appointed official lecturers to appear before the sections and the program was expanded to three lectureships. Dr. Lionel S. Marks delivered 18 lectures in the Northwest, on the Pacific Coast, and in the Southwest and South, and two in the East. Dr. Lillian M. Gilbreth met 15 appointments, principally in New England, New York, and the Central West. Prof. W. Trinks lectured in Detroit and at four New England points. As in the preceding

year, universal expression of approval was received from sections in 1946. Two lectureships are planned for 1947.

Sections held more meetings than during war years and attendance was reported as larger and more enthusiastic. The Metropolitan Section reported 74 meetings; Chicago, 29; Philadelphia, 19; Los Angeles, 18; and Ithaca, 14. All the sections held 556 meetings compared with 527 in the previous year. Los Angeles, through the local engineering council, staged a dinner meeting of 600 at which President Yarnall awarded the Holley Medal to Dr. Ernest O. Lawrence.

Innovations in section program-making included a plan of regular plant trips by the Los Angeles Section and a lecture program by the Washington Section. A new section, called Central Iowa, was established at Des Moines, Ia. Philadelphia established subsections at Trenton, N. J., and Wilmington, Del.

The West Virginia Section attracted attention through the article by its secretary in June, 1946, MECHANICAL ENGINEERING, "How to Be a Secretary and Enjoy It!" The successful program of meetings with large attendance proved that this section had a good organization as well as a secretary who could write interestingly of his work.

RESEARCH

This year the research committees of the Society sponsored twelve technical sessions at the regularly scheduled meetings of the Society and provided the papers for the programs of other sessions of meetings of the A.S.M.E. and other societies. Among the committees sponsoring these sessions were Metal Cutting Data and Bibliography, Cutting Fluids, Fluid Meters, Lubrication, Boiler Feedwater Studies, Critical-Pressure Steam Boilers, and Effect of Temperature on the Properties of Metals. In addition, seventeen of the special and joint research committees held one or more meetings during the year.

The final report of the Research Committee on Finishing and Machining of High Explosive Steel Shells was completed and issued on April 1, 1946.

WELDING RESEARCH COUNCIL

In October, 1945, the Society accepted joint sponsorship with the American Institute of Electrical Engineers and the American Welding Society for a new comprehensive research on pressure vessels, to cover materials, design, fabrication, testing, and inspection of these vessels.

The Society also joined with the American Institute of Electrical Engineers, the American Welding Society, and the other Founder Societies of The Engineering Foundation in sponsoring the Welding Research Council which "assembles, digests, and publishes available information regarding welding research; correlates existing programs in universities, governmental and industrial laboratories; and stimulates and conducts needed research in the welding field."

BOARD ON CODES AND STANDARDS

The Board on Codes and Standards, organized during the year, recommended expansion of the staff for codes and standards. This was approved by the Council. The board approved a recommendation to the Council that tentative standards, test codes, and safety-code projects be considered for nuclear-energy application.

STANDARDS

One American Standard was revised and seven new standards were published during the year, as follows: Involute Splines (Revision); Screw Threads for High-Strength Bolting; Gear Tolerances and Inspection; Life Tests for Single-Point Tools; Letter Symbols for Chemical Engineering; Steel Socket-Welding Fittings; Limits and Fits for Engineering and Manufacturing; and Brass or Bronze Screwed Fittings.

SAFETY

An "Industrial Safety Self-Appraisal Form" and a manual covering its use have been developed and are ready for final approval and publication. Progress has also been made in the revision of the Safety Code for Conveyers and Conveying Machinery, the Safety Code for Protection of Heads, Eyes, and Respiratory Organs of Industrial Workers, and the Safety Code for Prevention of Dust Explosions.

POWER TEST CODES

A far-reaching reorganization of committees was completed to meet the postwar need for power test codes.

The Committee on Instruments and Apparatus completed one new supplement, "Measurement of Power by Means of Dynamometers," and reissued three second editions of "Static and Total Pressure, Static Holes and Tubes, Impact Tubes," and "Smoke Density Determinations."

The first edition of the Test Code for Fans was issued in pamphlet form during the year as well as the revision of the Test Code for Stationary Steam-Generating Units.

BOILER CODE

The Subcommittee on Power Boilers has under way proportional-limit tests and tests to destruction for welded staybolt constructions for use in power boilers. Based upon recommendations from the Joint Conference Committee on Piping Codes and Standards, the rules for piping in the Power Boiler Code have been revised and issued in the 1946 addenda.

Provisions have been made for the use of non-Code steel plate in Code construction under the conditions given in case No. 1025. Pars. U-2, U-3, and U-10 of the Unfired Pressure Vessel Code have been revised to provide for the use of a rupture disk in series with safety valves on unfired pressure vessels. Also, Case No. 1026 was prepared which provides for the use of a steam safety valve in addition to water relief valves for hot-water heating boilers in closed systems.

Effective Jan. 1, 1947, manufacturers holding Code symbol stamps will be required to have a certificate of authorization for the use of each type of symbol. The 1946 edition of the A.S.M.E. Boiler Construction Code is in preparation.

THE SOCIETY AND THE PROFESSION

ENGINEERS JOINT COUNCIL

The Joint Conference Committee, organized in 1940, this year changed to the new name, The Engineers Joint Council. It is made up of the presidents, junior past-presidents, and secretaries of five societies (A.S.C.E., A.I.M.E., A.S.M.E., A.I.E.E., and A.I.Ch.E.). This Council considers matters of common concern to the societies and makes recommendations to the participants.

The Engineers Joint Council has several important projects under way. They include: (1) A study of the organization of the engineering profession; (2) a survey of the economic status of the engineer; and (3) a program of international relations.

The study of the organization of the profession has been focused largely on the means of organizing engineers for common purposes in the communities in which they live.

The economic-status survey is in three parts: (1) A survey of employer practice regarding engineering graduates; (2) a study of the earnings of engineers by a questionnaire sent to 88,000 engineers; and (3) the preparation of a manual on collective bargaining by engineers in professional work.

The international-relations program consists of: (1) The

collection of books for the libraries of devastated countries; (2) active co-operation with the various organizations of United Nations; (3) aid in organizing American participation in the International Technical Congress in Paris, Sept. 16–21, 1946, and the Sixth International Congress of Applied Mechanics, Paris, Sept. 22–29, 1946. In addition there is the task of welcoming and aiding the increasing number of engineers that are coming to this country from abroad.

Engineers Joint Council has also made important contributions to public service as has been mentioned.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

The Engineers' Council for Professional Development (E.C.P.D.), organized in 1932 to enhance the status of the engineer, is composed of three representatives from each of eight bodies, of which A.S.M.E. is one.

E.C.P.D. is participating with the Carnegie Foundation for the Advancement of Teaching in a measurement and guidance project in engineering education which has developed a test for prospective engineering students that has been administered to over 30,000 persons since its origin in 1943. Sophomore achievement tests are now in experimental form. It is expected that the entire project will have large significance in improving the educational process with consequent improvement to the profession.

Inspection and accrediting of curricula at noncollegiate technical institutes have been initiated and plans are being made for resumption of inspections of collegiate curricula.

E.C.P.D. completed a survey of engineering organizations in the United States and Canada at the request of Engineers Joint Council.

Five national societies have ratified, in substance, the Proposed Canons of Ethics for Engineers prepared by E.C.P.D. This approval is sufficient to justify the effort to reconcile minor differences and submit a revised document for general acceptance.

UNITED ENGINEERING TRUSTEES, INC.

The principal subject of study by the Trustees since October, 1945, has been the more adequate housing of the Founder and associate societies. The growth in membership and activities of the societies has made their need for increased space more pressing.

Engineering Societies Building, now forty years in service, is physically in excellent condition. Soundly constructed, the building may be adapted by certain alterations which may add the required additional space for immediate needs. Acquisition of adjacent properties may offer some relief. The building and land are carried on the books at $1,993,793.92, against which stands a depreciation fund of slightly less than $600,000.

United Engineering Trustees, Inc., was created for "the advancement of the engineering arts and sciences in all their branches and to maintain a free public engineering library." The Trustees have as departments Engineering Societies Library and The Engineering Foundation which render separate reports.

The control of the library, building, and Foundation funds is in the hands of the Board of Trustees. These funds, together with the titular ownership of Engineering Societies Building, constitute total assets of $3,500,000 for the engineering profession through the Founder Societies.

THE ENGINEERING FOUNDATION

The Engineering Foundation was established for "the furtherance of research in science and engineering and the advancement in any other manner of the profession of engineering and the good of mankind."

Because the Foundation's income is limited, it has adopted the policy of acting as a catalyzing agent in initiating studies and bringing them to the point where industry becomes interested and contributes heavily, or takes over the research entirely. The support by the Foundation has thus usually been magnified many times by outside contributions.

During the current fiscal year nine projects have been aided by the Foundation; the five listed below being in co-operation with The American Society of Mechanical Engineers:

Lubrication, the co-ordination of data on viscosity of lubricants under pressure.

Fluid meters, the measurement of pulsation flow.

Metal-cutting data, the revision of the manual on cutting of metals.

Plastic flow of metals, the friction at extreme pressures and at high temperatures; stress-strain relations in various drawing processes; rolling of metals.

Rolling friction, pure rolling friction as distinguished from bearing friction and all other resisting forces.

ENGINEERING SOCIETIES LIBRARY

The Engineering Societies Library reports increasing use of its facilities especially by telephone, telegraph, and letter inquiry. This increased use coupled with the need for restoring some losses due to war shortages of literature and rising costs have increased the difficulty of maintaining the necessary service with the fixed income of the Library.

Harrison W. Craver retired as director after nearly thirty years of service and Ralph H. Phelps was appointed acting director.

REGISTRATION OF ENGINEERS

Eighty-five thousand engineers are now registered in 47 states and 3 territories. Montana is now the only state which does not require registration of engineers.

A revision in the "model law" was approved by the Society.

Illinois adopted a new law to replace the one held unconstitutional. Several states modified their laws to include provision for the engineer in training.

EMPLOYMENT SERVICE

The Society co-operates in the operation of Engineering Societies Personnel Service, Inc., which has offices in New York, Chicago, Detroit, and San Francisco. During 1945, the service registered 3561 engineers and placed 828. More than 600 unfilled positions were on the books at the end of the year.

THE ADMINISTRATION OF THE SOCIETY

The Council met twice; at the 1945 Annual Meeting in November, 1945, and at the 1946 Semi-Annual Meeting in Detroit in June, 1946. The Executive Committee met monthly.

In addition to visits to the five sections on the Pacific Coast, the President visited about twenty sections and student branches.

The first results of a comprehensive study of member interests and society service were published during June, 1946.

VICE-PRESIDENTS AND REGIONAL ADMINISTRATIVE COMMITTEES

For the first time, the vice-presidents who took office at the 1945 Annual Meeting were selected by the sections organized in regions and each vice-president has authority and responsibility to exercise leadership in his region, particularly in matters affecting the sections, student branches, and membership development. The vice-presidents met in New York, in Chattanooga in April, and in Detroit in June, and gave intensive consideration to their new problems and responsibilities.

The more formal organization of sections in each region into a Regional Administrative Committee, authorized at the 1945

Annual Meeting, was put into effect during the spring when the Regional Committees met under the chairmanship of the vice-presidents. The first meeting held was that of Region IV at Chattanooga on March 30 and 31, 1946. This was attended by all the vice-presidents so they could participate and gain experience in this new administrative procedure.

Delegates from the eight regions met in Detroit previous to the 1946 Semi-Annual Meeting, reviewed the actions of the regional Administrative Committees on matters of Society policy and formulated recommendations to the Council concerning them.

The Standing Committee on Sections was relieved of its By-Law responsibilities and is being kept in an advisory status for an additional year until the new plan of vice-presidential responsibility is more firmly established.

The status of the Committee on Relations With Colleges which supervises student-branch activities has been altered by appointing a man in each region to aid the vice-president on student-branch matters and to serve as an advisory committee on student branches.

ORGANIZATION OF BOARDS AND COMMITTEES

The grouping of the committees of the Society under six Boards and the Council was approved by the Council and By-Law changes were authorized to be effective at the 1946 Annual Meeting. The Board on Codes and Standards was organized on the new basis during the year and initiated its work by recommending new policies that were adopted for increasing standardization activities. The remaining Boards will be organized after the new By-Law provisions are adopted.

During the year the newly authorized Committee on Organization devoted its efforts: (1) to developing policies for selection of committee members, (2) to reviewing nominations received for committee appointments; and (3) to co-operation with the Committee on Constitution and By-Laws in formulating By-Law changes.

FINANCES

The detailed report of the Committee on Finance which follows and is a part of the Council report shows an increase in income and expense over the previous year.

A gift of $4000 for the Charles T. Main Fund was received.

WOMAN'S AUXILIARY

The Woman's Auxiliary has five local sections: Cleveland, Chicago, Los Angeles, New York, and Philadelphia. The Chicago Section was established this year and is starting its work with enthusiasm.

The Student Loan Fund, a revolving fund that has served 54 students, is in excellent financial condition with a balance of $8206.86.

The Calvin W. Rice Memorial Scholarship for foreign engineering students was withheld this year because of the enormous demand being made on our educational facilities by veterans.

MEMBERSHIP

As shown in Table 2, the society membership on Sept. 30, 1946, was 21,536, the largest in the history of the Society, exceeding the previous peak of 20,060 in 1930. For the first time in several years an increase is shown for each class of members.

The following membership actions were taken during the year

Applications pending, October 1, 1945	537
Applications received during the fiscal year 1945–1946	2530
Total applications handled during the year 1945–1946	3067
Recommended for membership	2494
Transfer denied	32
Deferred	43
Withdrawn, incomplete, and canceled	49
Deceased	1
Applications pending September 30, 1946	448

The 2494 recommended for membership were divided into the following grades:

Fellow	1
Transfer to Fellow	24
Members	737
Transfer to Member	285
Associates	62
Transfer to Associate	6
Juniors	461
Transfer from Student Member to Junior	918
Total recommended	2494
Transfers	305
Total New Members recommended	2189

BOARD OF REVIEW

	1945–1946	1944–1945	1943–1944
Cancellation of dues	11	8	0
Resignations	137	112	120
Reinstatements	143	151	135
Reinstatements voided	8	20	0
Previous dropped or resigned actions rescinded	106	105	81

MEMBERSHIP DEVELOPMENT

The Special Committee on Membership Development, which was reorganized during the year, is to be converted to a Standing Committee with representation of the eight Regions.

The principal activity has been the development of an active program of co-operation between Professional Divisions and Sections in following up nonmembers who have attended A.S.M.E. meetings.

TABLE 2 CHANGES IN MEMBERSHIP

(Sept. 30, 1945 to Sept. 30, 1946)

	Membership		Increases			Decreases				Changes		
	Sept. 30, 1946	Sept. 30, 1945	Transferred to	Elected	Reinstated	Transferred from	Resigned	Dropped	Died	Increases	Decreases	Net change
Honorary members	41	36	4	1						5		+ 5
Fellows	192	172	31		1	4			8	32	12	+ 20
Members	10379	9607	294	568	166	31	66	60	99	1028	256	+ 772
Associates	305	245	6	57	4		2	1	4	67	7	+ 60
Junior (20)	2548	2197	492	55	60	172	25	51	8	607	256	+ 351
Junior (15)	2029	1776	766	117	45	620	17	34	4	928	675	+ 253
Junior (10)	6042	5655		1250	90	766	27	147	13	1340	953	+ 387
Total membership	21536	19688	1593	2048	366	1593	137	293	136	4007	2159	+1848

THE SECRETARY'S OFFICE

The sharp increase of postwar activity made it necessary, and the war's end made it possible, to make the too-long-delayed additions to the staff of the Secretary's office. Twelve additions were made during the year bringing the number on the permanent staff to 101. The Secretary, Col. C. E. Davies, who had been granted leave of absence for service in the War Department, returned to full service with the Society just prior to the 1945 Annual Meeting.

The additional staff and the reduction of an overcrowed condition, grown up over the years, made necessary the rental of 3000 square feet in a nearby building for the publication staff.

During the Annual Meeting, honoraria were given and the appreciation of the Council expressed to four members of the staff who have served 25 years: C. E. Davies, Marie J. Mullan, Leslie Scanlan, and Benjamin Theroux.

The resignation of Dean R. L. Sackett (followed by his death on October 6, 1946) was a serious loss to the staff on which he had served during the war years.

DEATHS

The Society lost through death one of its Council members — Alex. R. Stevenson, Jr., Vice-President Region III, on August 28, 1946; and B. V. E. Nordberg, nominee for Director, on August 19, 1946.

Charles Adkins Baker, who had served as legal counsel for the Society for many years, died on December 7, 1945.

COMMITTEE REPORTS

The complete reports of the committees of the Society and of its representatives on joint agencies are embodied in a pamphlet of 64 pages which is available upon request.

A.S.M.E. FINANCE COMMITTEE REPORT, 1945-1946

THE Finance Committee's functions and activities have in previous annual reports been fully described and discussed and your Finance Committee during the past year has followed along the previously prescribed lines.

It should always be borne in mind that the Council, directly or through its Executive Committee, is the policy-making body of the Society and the Finance Committee rightfully so regards it in connection with all matters referred to or originating in the Finance Committee. Our actions or recommendations must be and are all subject to final approval by the Council. The Chairman of the Finance Committee is an ex-officio advisory member of the Executive Committee and the Executive Committee appoints two Council members to serve as active voting members of the Finance Committee. The two groups thus co-operate very closely.

It is, however, essential and within the prerogatives of the Finance Committee that it give thought to and make recommendations to the Council on all matters of finance and especially when a question arises as to expenditures not included in a previously approved budget. It has been the definite intention and aim of the Finance Committee to build up a reasonable surplus for future emergencies and lean years. Your Finance Committee feels that, under today's conditions, this surplus should under no circumstances be decreased nor imperiled at this time when there is so much money in circulation and with prospects of further increases in costs of materials and wages. Our surplus is definitely not out of line with our total yearly expenditures or the Balance Sheet Liabilities especially in view of the uncertainties that confront the world today. It should also be kept in mind that in actual dollar value, the surplus would be dissipated much more rapidly than would have been the case before the war.

The accompanying statements as to "Income and Expense per Member" should be of real interest to the membership, especially the Income and Expense of "Publications." These Publications are really an essential and necessary part of the Society's activities but, in the past few years, instead of being a net expense as was the case previous to 1942–1943, "Publications" through advertising income contributed an appreciable portion of the Surplus which has been regarded by the Finance Committee as in the nature of a "windfall" or from an accounting standpoint as a "nonrecurring" item. It will also be noted that the revenue from Membership Dues is higher this year than it has been for some twenty years but even with the increased revenue from Publications and from Membership Dues, the expense of carrying on our normal activities has also increased materially and the utmost caution must be observed to maintain the tentative balanced budget now approved for the year 1946–1947. The increase in staff salaries was an important factor in the increased expense but the Finance Committee was unanimous in its thought as to the equity and fairness of the staff expense increase.

Your Committee has continued during the past year to recommend the investment of Society funds in Government securities. Government securities do not yield an income comparable to speculative stocks but it is our thought that, as Trustees of the Society's funds, it is our first duty to safeguard these funds.

The character of the Society's investments is shown below but it should be noted that all "Stocks" are held in specific Trust Funds in accordance with the wishes of the sponsors.

Securities	Lower of Cost or Market
U. S. Government Securities	$ 970,263.01
Stocks and Bonds	43,399 22
Real Estate Mortgages and Certificates	14,779 54
Cash	112,614.05
Total	$1,141,055.82

Respectfully submitted,

W. H. SAWYER, *Chairman*
F. E. LYFORD, *Vice-Chairman*
G. L. KNIGHT
J. H. LAWRENCE
HARRY WHITAKER
A. J. KERR } *Council Representatives*
DAVID LARKIN }
K. W. JAPPE, *Treasurer*
J. L. KOPP, *Assistant Treasurer*

OPERATING SUMMARY

A Balance Sheet. Accountants' Opinion

B Comparative summary of income, expenses and appropriations, and surplus

C Statement of changes in funds

D Detailed cost of activities

E How the A.S.M.E. spent its 1945–1946 income.

The Balance Sheet, Exhibit A, of September 30, 1946, shows, on that date, that the Society owed:

(1) Current bills and Federal Tax withheld from Employees	$ 9,545.08	
(2) Obligations for printing and distributing the 1947 Mechanical Catalog and other bills which have not been submitted	47,553.08	
(3) Unexpended appropriations for future services	103,047.36	
(4) Special research and other committees which have collected funds for special purposes to be expended as needed	86,667.03	
(5) Future services to members who have prepaid dues	136,073.09	
(6) Subscribers to publications who have prepaid	4,000.00	
	$386,885.64	

To meet these debts the Society had:

(1) Cash in the bank	$ 94,098.71	
(2) Accounts receivable	111,716.74	
(3) Inventories of publications and supplies conservatively valued at	34,800.01	
(4) Securities (at the lower of cost or approximate quoted market values)	676,405.24	
	$917,020.70	

The difference between the value held by the Society of $917,020.70 and debts of $386,885.64 is net worth of the Society on September 30, 1946 ..... $530,135.06

The Society had other liabilities:

(1) Development Fund of		$ 98,498.17
(a) Cash	$ 10,396.61	
(b) Securities (at the lower of cost or approximate quoted market values)	88,101.56	
	$ 98,498.17	
(2) Employees' Retirement Fund of covered by:		$119,935.40
(a) Cash	$ 4,563.65	
(b) Securities (at the lower of cost or approximate quoted market values)	115,371.75	
	$119,935.40	
(3) Trust funds amounting to against which the Society had the following assets:		$152,218.30
(a) Cash	$ 3,555.08	
(b) Note receivable	100.00	
(c) Securities (at the lower of cost or approximate quoted market values)	148,563.22	
	$152,218.30	
(4) Property fund of with the following assets to support it:		$541,403.75
(a) Quarter interest in building	$498,448.48	
(b) Office furniture and fixtures (depreciated value)	42,953.27	
(c) Library books	1.00	
(d) Engineering Index, Inc.—Title and good will	1.00	
	$541,403.75	

EXHIBIT A—BALANCE SHEET—SEPTEMBER 30, 1946

ASSETS

GENERAL FUND:			
Cash (Note 1)			$ 94,098.71
Accounts receivable:			
Publication activities, less reserve of $2,467.18	$104,224.38		
Travel advances, etc.	7,492.36		111,716.74
Inventories, at cost:			
Publications—completed and in process, less reserve of $4,470.94	$ 28,596.21		
Supplies	6,203.80		34,800.01
Investments (Note 2):			
U. S. Treasury Bonds	$399,371.25		
U. S. Savings Bonds, Series F and G	264,554.45		
Mortgage certificate	12,479.54		676,405.24
		$	917,020.70
DEVELOPMENT FUND:			
Cash (Note 1)	$ 10,396.61		
U. S. Treasury Bonds (Note 2)	88,101.56		98,498.17
EMPLOYEES' RETIREMENT FUND:			
Cash (Note 1)	$ 4,563.65		
U. S. Savings Bonds, Series F (Note 2)	36,811.75		
U. S. Treasury Bonds (Note 2)	78,560.00		119,935.40
TRUST FUNDS:			
Cash (Note 1)	$ 3,555.08		
Note receivable	100.00		
Investments (Note 2):			
Public utility and railroad stocks and bonds	$43,399.22		
Mortgage certificate	2,300.00		
U. S. Savings Bonds, Series G	56,404.00		
U. S. Treasury Bonds	46,460.00	148,563.22	152,218.30
PROPERTY FUND:			
Founder's one-fourth interest in real estate and certain other assets of United Engineering Trustees, Inc.	$498,448.48		
Furniture and fixtures, less depreciation	42,953.27		
Library books	1.00		
Engineering Index, Inc.—title and goodwill	1.00		541,403.75
			$1,829,076.32

LIABILITIES

GENERAL FUND:			
Accounts payable			$ 9,545.08
Accrued liabilities			47,553.08
Deferred credits:			
Dues and initiation fees paid in advance	$136,073.09		
Prepaid subscriptions	4,000.00		140,073.09
Unexpended balances:			
Custodian funds (Note 4)	$ 86,667.03		
Appropriations (Note 5)	103,047.36		189,714.39
Surplus (Exhibit B)			530,135.06
		$	917,020.70
DEVELOPMENT FUND (Exhibit C)			98,498.17
EMPLOYEES' RETIREMENT FUND (Exhibit C)			119,935.40
TRUST FUNDS, including unexpended income (Exhibit C)			152,218.30
PROPERTY FUND			541,403.75
			$1,829,076.32

NOTES TO FINANCIAL STATEMENTS

NOTE 1—CASH:

Separate bank accounts are not maintained for the cash applicable to the several funds. Records are maintained, however, which indicate the portion of total cash pertaining to each fund.

NOTE 2—INVESTMENTS:

Investments are carried at cost or approximate quoted market values, whichever is lower, except that U. S. Savings bonds are carried at current redemption values and the mortgage certificate held in the general fund, and written down in prior years, is carried at an amount less than cost and less than current market value.

Interest and dividends on investments are recorded only as collected.

NOTE 3—MEMBERSHIP DUES AND FEES:

Membership dues for the current and prior years are included in the income account as collected and initiation and member promotion fees collected are credited to surplus upon admission or promotion of members. At September 30, 1946, uncollected membership dues applicable to the current and prior years amounted to $8,210.68 and $230.83 respectively.

NOTE 4—CUSTODIAN FUNDS:

For the purpose of undertaking special research and other projects, the Society receives funds from various interested organizations. Transactions in such funds, which are carried as "Custodian Funds," are not reflected in the summary of income, expenses and appropriations, and surplus. For the year ending September 30, 1946, recorded contributions amounted to $46,472.15, of which $10,000 was contributed by the Development Fund, interest collected amounted to $334.99 and disbursements amounted to $26,070.07.

NOTE 5—UNEXPENDED APPROPRIATIONS:

The summary of income, expenses, and appropriations includes charges for unexpended balances at September 30, 1946, and September 30, 1945, of appropriations made in the respective years then ending, as follows:

	1945–1946	1944–1945
Expenses under supervision of various committees	$ 6,257.00	$ 8,270.58
Publication expenses	12,200.00	19,080.29
Office expenses	27,078.70	50,529.25
	$45,535.70	$77,880.12

Unexpended appropriations as at September 30, 1946, amounting to $103,047.36 comprised the amount of $45,535.70 shown above as appropriated in the 1945–1946 fiscal year and $57,511.66 appropriated in prior years.

EXHIBIT B

GENERAL FUND

COMPARATIVE SUMMARY OF INCOME, EXPENSES, AND APPROPRIATIONS AND SURPLUS

For the Two Years Ending September 30, 1946 and September 30, 1945

	1945–1946	1944–1945
INCOME:		
Initiation and member promotion fees (credited directly to surplus) (Note 3)	$ 24,135.00	$ 21,416.86
Membership dues (Note 3)	$301,260.23	$273,698.96
Publication income:		
Circulation sales	109,518.69	95,403.19
Advertising	390,730.30	410,671.75
Student dues and registration fees	10,247.30	10,930.91
Other income:		
Interest (Note 2)	14,606.30	10,912.08
Sales of emblems, membership certificates, etc	4,384.76	3,646.68
Income from Engineering Index, Inc	1,825.00	1,622.52
Sale of equipment		725.00
Total income	$832,572.58	$807,611.09
EXPENSES AND APPROPRIATIONS:		
Expenses under supervision of various committees	$140,624.28	$118,830.29
Publication expenses	238,867.03	209,058.86
Office expenses	449,307.23	379,393.43
Total expenses and appropriations (Note 5)	$828,798.54	$707,282.58
EXCESS OF INCOME OVER EXPENSES AND APPROPRIATIONS	$ 3,774.04	$100,328.51
Surplus balance at beginning of period	491,987.56	390,000.00
Initiation and member promotion fees (Note 3)	24,135.00	21,416.86
Transfer from Trust Funds—unused balance of life membership dues of a deceased member	333.93	
Profit on sales of investments	9,239.73	
Balances of prior years' appropriations against which no additional charges are anticipated	1,809.69	904.79
Other additions or (deductions)	256.41	(120.60)
	$531,536.36	$512,529.56
Less:		
Special appropriation to employees' retirement fund		$ 20,000.00
Adjustment of carrying value of investments	$ 1,401.30	542.00
	$ 1,401.30	$ 20,542.00
SURPLUS BALANCE AT END OF PERIOD	$530,135.06	$491,987.56

EXHIBIT C

STATEMENT OF CHANGES IN FUNDS

Year Ending September 30, 1946

DEVELOPMENT FUND		
BALANCE, SEPTEMBER 30, 1945		$ 93,535.67
ADD:		
Interest on investments (Note 2)		2,175.00
Contributions		12,875.00
		$ 108,585.67
DEDUCT:		
Transfer to General Fund as a contribution to the special custodian fund for Metals Engineering Handbook, as authorized by the Executive Committee	$10,000.00	
Investment custodian fees	87.50	10,087.50
BALANCE, SEPTEMBER 30, 1946		$ 98,498.17
EMPLOYEES' RETIREMENT FUND		
BALANCE, SEPTEMBER 30, 1945		$144,539.45
ADD:		
Interest on investments (Note 2)		2,543.86
Profit on sales of investments		2,906.26
		$149,989.57
DEDUCT:		
Annuities purchased	$29,491.67	
Adjustment of carrying value of investments	463.77	
Investment custodian fees	98.73	30,054.17
BALANCE, SEPTEMBER 30, 1946		$119,935.40
TRUST FUNDS		
BALANCE, SEPTEMBER 30, 1945		$145,873.25
ADD:		
Interest and dividends on investments (Note 2)		4,149.67
Profit on sales of investments		804.03
Contributions		4,200.00
Life memberships purchased		1,790.86
Transfer from General Fund-income—the amount required to place the investment of paid-up life membership dues on a 2-1/2% annual interest basis		112.94
		$156,930.75
DEDUCT:		
Expenditures for prize awards, etc	$ 2,435.17	
Proportion of life membership dues applicable to current year transferred to General Fund-income	820.00	
Adjustment of carrying value of investments	1,068.06	
Transfer to General Fund surplus, unused balance of life membership dues of a deceased member	333.93	
Investment custodian fees	55.29	4,712.45
BALANCE, SEPTEMBER 30, 1946		$152,218.30

ACCOUNTANTS' OPINION

TO COUNCIL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

We have examined the balance sheet of The American Society of Mechanical Engineers as of September 30, 1946, and the summary of income, expenses, and appropriations and surplus of the general fund, and statement of changes in funds for the fiscal year ending that date. Our examination was made in accordance with generally accepted auditing standards applicable in the circumstances, and included such tests of the accounting records and other supporting evidence and such other procedures as we considered necessary. However, contributions received during the year from members, organizations, and others were not confirmed by us as it is not practicable to do so.

In our opinion, based upon our examination, the accompanying balance sheet and related summary of income, expenses, and appropriations and surplus of the general fund, and statement of changes in funds present fairly the position of The American Society of Mechanical Engineers at September 30, 1946, and the results of its operations for the fiscal year on the basis indicated in the accompanying notes and the appended statements. Such basis is consistent with that of the preceding year.

(Signed) PRICE, WATERHOUSE & CO.

New York, N. Y.
November 8, 1946

EXHIBIT D—DETAILED COST OF A.S.M.E. ACTIVITIES 1945-1946

(Approved by Finance Committee October 17, 1946)

	Under Committee Supervision			Printing and distribution	Office expense	Totals
	Joint Bodies	Members Travel	Others			
Publications, Standards, Codes and Research						($459,393.89)
MECHANICAL ENGINEERING—Text Pages (Excluding Student Copies)				$ 37,313.15	$ 21,202.96	58,516.11
MECHANICAL ENGINEERING—Advertising Pages				60,652.62	59,505.76	120,158.38
Transactions (Including *Journal of Applied Mechanics*)			$ 194.68	48,718.11	15,049.87	63,962.66
Membership List				5,529.41	6,802.21	12,331.62
A.S.M.E. Mechanical Catalog				39,250.10	42,557.84	81,807.94
Publication Sales (Except Standards, Codes and Research Reports)				14,637.67	8,035.48	22,673.15
Standards and Codes	$ 1,000.00			24,117.20	32,703.06	57,820.26
Research				2,994.72	39,129.05	42,123.77
General Society Activities						(147,664.93)
Society Meetings (Including Publicity)			24,835.52		11,131.97	35,967.49
Sections (Including Regional Administrative Committee of Regional Delegates Conference)		$ 8,797.76	36,534.11		13,670.38	59,002.25
Professional Divisions			4,691.98		10,927.59	15,619.57
Student Branches (Including Student Copies of MECHANICAL ENGINEERING)		3,931.50	5,401.34	5,654.05	6,744.44	21,731.33
Admissions					13,511.97	13,511.97
Awards			678.37		1,153.95	1,832.32
General Society Administration						(38,159.68)
Council		6,512.20	1,462.78			7,974.98
Membership Development			2,500.00		1,084.26	3,584.26
Professional Services (Auditors, Counsel, etc.)			2,220.45			2,220.45
Nominating Committee		1,199.21				1,199.21
Retirement Fund			22,680.78			22,680.78
"Know Your Society" (Organization Charts)			500.00			500.00
Joint Activities						(17,483.60)
Engineering Societies Library	10,385.60					10,385.60
Engineers' Council for Professional Development	2,416.00					2,416.00
Engineers Joint Council	2,332.00					2,332.00
Engineering Societies Personnel Service, Inc. (Reserve)	2,000.00					2,000.00
Registration (National Council of State Boards of Engineering Examiners)	350.00					350.00
Indirect Expenses						(166,096.44)
Secretary's Office					46,417.90	46,417.90
Accounting Department					26,034.36	26,034.36
General Service (Stores, Mailing, etc.)					49,404.12	49,404.12
General Office (Rent, etc.)					44,240.06	44,240.06
	$18,483.60	$20,440.67	$101,700.01	$238,867.03	$449,307.23	$828,798.54

How the A.S.M.E. Spent Its Income in 1945-1946

EXHIBIT E

Dues Income: $301,260.23—$13.99 per Member.

The principal item of income is the dues paid by the members. Juniors pay $10, $15, or $20 depending upon their age; Members pay $20, Fellows, $25, except that those who have been on the rolls of the Society for 35 years or who have reached 70 and have been members 30 years are carried without dues. On September 30 the Society had 21,536 members on its rolls and during the year $301,260.23 was collected in dues. The per-member dues income is therefore $13.99.

General Income: $20,816.06—$.96 per Member.

The Society derived income from sources such as interest on investments, cash discount on purchases of supplies, sales of emblems and membership certificates, and income from Engineering Index, Inc. on a contractual basis. The following tabulation shows the amounts of income received.

Interest and discount	$14,606.30
Sales of emblems and certificates	4,384.76
Engineering Index, Inc.	1,825.00
	$20,816.06
General Income per Member	$ .96

Publications: Net Expense $55,144.37—$2.56 per member

The publications of the Society are MECHANICAL ENGINEERING, Transactions, including the *Journal of Applied Mechanics*, the Membership List, and the A.S.M.E. Mechanical Catalog and Directory. Income is obtained from advertising in MECHANICAL ENGINEERING and in the Catalog.

The Society has over four hundred technical committees en-

gaged in the work on research, establishing power test codes, preparing the boiler code, and preparing standards and safety codes, the income and cost of which are shown in the following table.

PUBLICATIONS, STANDARDS, CODES, AND RESEARCH

	Total expense	Total income
MECHANICAL ENGINEERING text pages (excluding $5,654.05 for Student Copies)	$ 58,516.11	
MECHANICAL ENGINEERING advertising pages	120,158.38	$289,645.80
Transactions (including *Journal of Applied Mechanics* and Membership List)	76,294.28	
A.S.M.E. Mechanical Catalog	81,807.94	101,084.50
Publication Sales (except Standards, Codes, and Research Reports)	22,673.15	47,673.19
Standards and Codes	57,820.26	50,861.62
Research Reports	42,123.77	10,983.88
	$459,393.89	$500,248.99
Indirect expense (rent, overhead, etc.)	95,999.47	
	$555,393.36	
Less Income	500,248.99	
	$ 55,144.37	
Net Expense per Member	$ 2.56	
Total publication expense per member	$ 20.17	
Publication income per member	20.36	
Net publication income per member		$ .19
Standards, codes, and research expense per member	5.62	
Standards, codes, and research income per member	2.87	2.75
Net expense per member		$ 2.56

General Society Activities: Net Expense $168,080.65—$7.80 per Member.

The general activities of the Society include the holding of meetings, the operation of Sections, Professional Divisions, Student Branches, the administration of the procedure for admitting members to the Society, and the bestowal of awards. The Society receives income from Students for their membership in the Society. The following tabulation shows the net expense for this activity.

GENERAL SOCIETY ACTIVITY

	Total expense	Total income
Society Meetings (including publicity)	$ 35,967.49	$ 585.00
Sections (including Regional Administrative Committee and Regional Delegates Conference)	59,002.25	
Professional Divisions	15,619.57	
Student Branches (including Student Copies of MECHANICAL ENGINEERING)	21,731.33	9,662.30
Admissions (expenses for Committee on Admissions)	13,511.97	
Awards	1,832.32	
	$147,664.93	$10,247.30
Indirect Expense	30,663.02	
	$178,327.95	
Less Income	10,247.30	
Net cost of General Society Activities	$168,080.65	
Total expense of General Society Activities per Member	$ 8.28	
Income per Member	.48	
Net expense per Member	$ 7.80	

Administration: Net Expense $57,792.07—$2.68 per Member.

In carrying out the Society activities, certain administrative services must be provided. These include the expense of the Council, the Nominating Committee, the Retirement Fund, and the provision for auditing, legal, and other services. The following tabulation shows the amount of this expense and income.

GENERAL SOCIETY ADMINISTRATION

	Total expense
Council	$ 7,974.98
Membership Development	3,584.26
Professional Services (Auditors, Counsel and Bonding)	2,220.45
Nominating Committee	1,199.21
Retirement Fund	22,680.78
"Know Your Society" (Pamphlet describing Society Organization)	500.00
	$38,159.68
Indirect expense	19,632.39
Total Cost—General Society Administration	$57,792.07
Expense per member	$ 2.68

Joint Activities: Net Expense $37,285.16—$1.73 per Member.

The Society also participates in a number of joint activities such as the Library, Engineers' Council for Professional Development, and the joint Employment Service. In addition to the payments to these joint bodies for these purposes a certain amount of general expense is allocated to these activities. The following tabulation gives the total of this expense.

JOINT ACTIVITIES—FOR ADVANCING THE PROFESSION

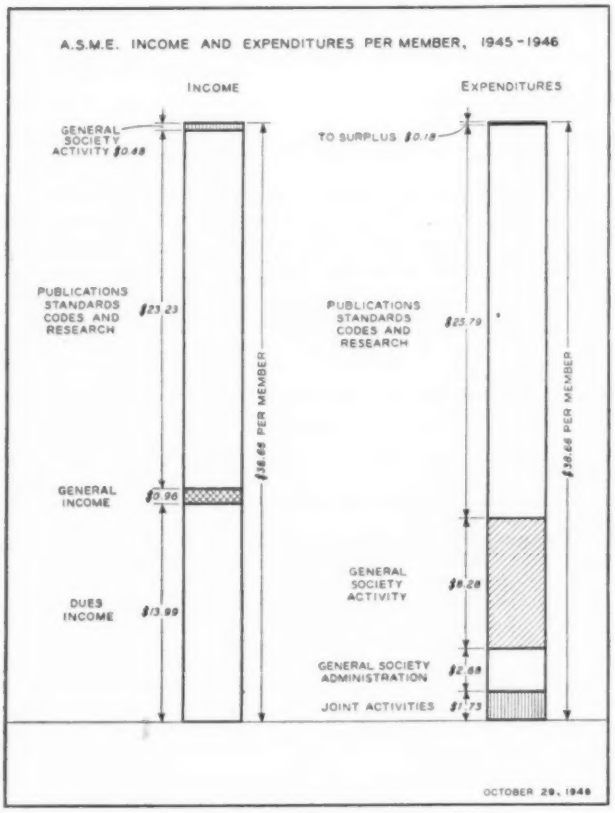
	Total expense
Engineering Societies Library ($5,000 plus 30¢ per member)	$10,385.60
Engineers' Council for Professional Development	2,416.00
Engineers Joint Council	2,332.00
Engineering Societies Personnel Service, Inc. (reserve)	2,000.00
Registration (National Council of State Boards of Engineering Examiners)	350.00
American Standards Association ($1,000 included in Standards and Codes)	
	$17,483.60
Indirect expense	19,801.56
Total Cost of Joint Activities	$37,285.16
Expense per member	$ 1.73

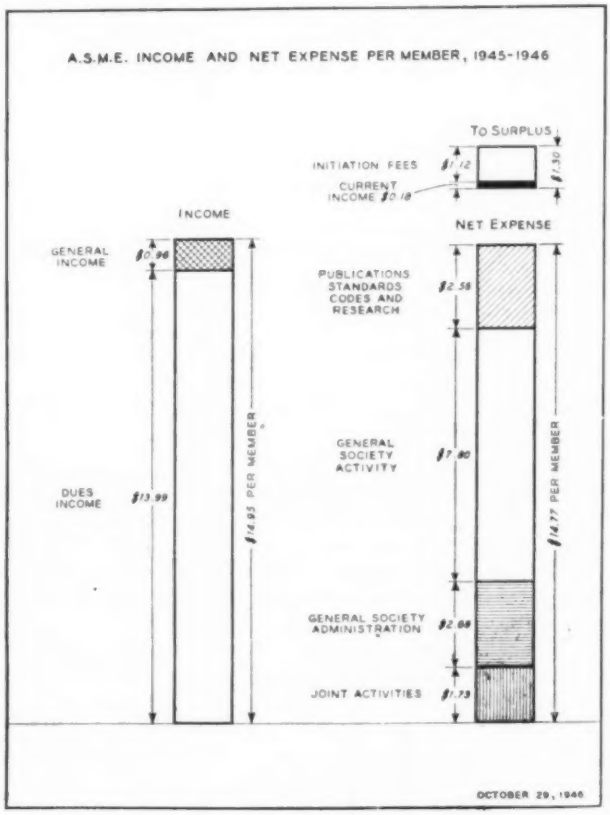
RECAPITULATION

	Expense	Income	Net
Dues	$	$301,260.23	+$301,260.23
General Income	....	20,816.06	+ 20,816.06
Publications, Standards, Codes, and Research	555,393.36	500,248.99	− 55,144.37
General Society Activity	178,327.95	10,247.30	− 168,080.65
General Society Administration	57,792.07	.....	− 57,792.07
Joint Activities	37,285.16	.....	− 37,285.16
Total expense	$828,798.54		
Addition to surplus from operating income	3,774.04	.....	− 3,774.04
	$832,572.58	$832,572.58	
Initiation fees (Direct to Surplus)		24,135.00	
Total addition to surplus		27,909.04	

INCOME AND EXPENSE PER MEMBER

	Expense per member	Income per member	Net expense per member
Dues		$13.99	
General Income		.96	
		$14.95	
Publications, Standards, Codes, and Research	$25.79	$23.23	$ 2.56
General Society Activity	8.28	.48	7.80
General Society Administration	2.68		2.68
Joint Activities	1.73		1.73
Addition to surplus from operating income	.18		.18
	$38.66	$38.66	$14.95
Addition to surplus from initiation fees			$ 1.12
Total addition to surplus			1.30





1946 A.S.M.E. ANNUAL MEETING CROWDS WEEK, DEC. 2-6

Rockets and Jet Propulsion Excite Discussion at Hotel Pennsylvania, New York, N. Y.

I—INTRODUCTION

NEW developments in mechanical engineering, availability of time in which to prepare papers on wartime developments not previously discussed, and important matters of professional and Society interest crowded the program of the Sixty-Seventh Annual Meeting of The American Society of Mechanical Engineers, held at the Hotel Pennsylvania, New York, N. Y., Dec. 2–6, 1946. An attendance of 5000 was registered during an active week. Society affairs were discussed at meetings of the Council and the Executive Committee, which commenced on Sunday, December 1, and at the Annual Business Meeting, held on Monday, December 2. Reports of these meetings will be found on pages 57–61 of this issue.

The technical program, which began on Monday morning, listed 74 sessions at which 215 papers were presented. In addition to these public sessions the week was filled with committee meetings. Public luncheons and dinners numbered 12, while numerous other luncheons and dinners of small groups and committees were scheduled. Topping the list of these events was the Annual Dinner, held in the Ballroom on Wednesday evening. A complete program of activities for women visitors, under the auspices of the A.S.M.E. Woman's Auxiliary, ran concurrently and featured a tea dance on Monday afternoon. Opportunity was afforded for members and guests to take advantage of their stay in New York to attend the first national convention of the American Rocket Society, which sponsored several sessions jointly with A.S.M.E., and to visit many industrial establishments and power-generating stations in regularly scheduled plant trips, including one to the United Nations at Lake Success, L. I.

Although the Society is exerting strenuous efforts to return to the prewar practice of requiring papers to be ready 90 days in advance of meetings so that preprints can be made available and a complete program can be printed in MECHANICAL ENGINEERING, this ideal was not universally attained. The advance program published in the November issue of MECHANICAL ENGINEERING was not completed and members were forced to wait for the official program which was distributed at the hotel in order to make a last-minute check-up on times and places of events they wished to witness. In spite of late arrival at headquarters of a majority of the papers presented, almost all preprints were available at the meeting.

Because of the extent of the program and the limited time in which a report could be prepared, it is possible in this account to touch on only the high lights that will interest the greatest number of readers. Many of the technical papers will be printed in the Society's publications, MECHANICAL ENGINEERING, Transactions, and the *Journal of Applied Mechanics*, as soon as they can be prepared with the discussion they evoked. A limited number of preprints of some of the papers are available and can be purchased, as long as the supply lasts, at the A.S.M.E. Publications Sales Department.

II—TECHNICAL PROGRAM

A study of the technical-paper program of the 1946 A.S.M.E. Annual Meeting will reveal the fact that the bulk of the papers can be grouped in five major categories: Applied mechanics; heat transfer; power, fuels, and related subjects; metal cutting and production engineering; and management and education. In addition there were featured papers on industrial instruments, rubber and plastics, materials handling, wood industries, railway equipment, textiles, and aviation, although some of the papers in these fields are also closely related to the major categories just mentioned. In the brief summaries that follow an attempt has been made to record some general impressions and a few high lights. Mention of every paper is of course impossible in such a brief account as space and time permit. Some of the contributions of the research committees are mentioned in another section of this report, which is devoted to the activities of A.S.M.E. Technical Committees.

APPLIED MECHANICS

The Applied Mechanics Division sponsored eight sessions at the 1946 Annual Meeting. The papers presented covered a variety of subjects. Three of the sessions were held jointly with the Metals Engineering Division and the A.S.M.E. Research Committee on Plastic Flow of Metals, and a fourth was a gas-turbine seminar held jointly with the Aviation Division. Many of the papers presented will be published in the *Journal of Applied Mechanics* and other Society publications.

HEAT TRANSFER

Featured on the Heat-Transfer program this year were papers concerned with aircraft heat transfer and instrumentation with particular reference to anti-icing and aircraft engine cooling.

A heated-glove system was described that has been devised for determining unit external heat-transfer coefficients as an aid to designing thermal anti-icing systems for aircraft.

The results obtained with a device used at Mt. Washington Observatory for measuring heat required to reach certain anti-icing conditions were presented.

A review of some German developments in airplane anti-icing revealed that for wings of conventional aircraft, the heated-air system had been adopted by the Germans as the most available means of ice protection, replacing rubber de-icer shoes, after 1938.

An investigation on the cooling of an 18-cyclinder, twin-row, radial, air-cooled engine in a high-performance pursuit airplane was reported for variable engine and flight conditions at altitudes ranging from 5000 to 35,000 ft in order to provide flight experimental basis for predicting high-altitude cooling performance from sea-level or low-altitude test results.

In addition, a Symposium on Radiant Heating in Industry was sponsored jointly by the Heat Transfer Division of the A.S.M.E., and the American Institute of Chemical Engineers.

Eugene W. O'Brien

President of
The American Society
of
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for 1947

The subject of electric radiant heating with particular reference to infrared heating was discussed. Radiant heating with incandescent lamps and gas-fired radiant heating were also covered.

Papers pertaining to the theory and design of heat exchangers were presented at a session sponsored jointly by the Heat Transfer and Process Industries Divisions.

METAL CUTTING

The major interest in metal cutting centered around machinability. Studies of tool performance, tool angles, and surface finish, etc., all are affected by the variations between similar workpieces caused by different microstructures. Surface finish, grinding, and cutting fluids were given serious attention as was the flow of metals under pressure.

PRODUCTION ENGINEERING

The first of the welded drier rolls replacing cast-iron rolls, appeared in 1930. A number of case histories were discussed and illustrated to show the factors considered in the development of the rolls of today. Safety against bursting under high pressure was one of the chief advantages cited.

MACHINE DESIGN

New problems in the design of broaching machines, a new approach in the design of machines based on the greater need for strength and rigidity, and the use of electric gages in advanced testing technique, pointed to advancements in machines. Designs to meet the needs of increased production, the simplification of methods, and the use of cutting materials capable of taking higher speeds and feeds than have been used in the past were emphasized.

GAS TURBINES AND POWER

New information in the field of steam power and the gas turbine was featured in the technical sessions sponsored by the Power and the Oil and Gas Power Divisions.

Engineering data and operating experience were described with a new method of burning coal in a horizontal cyclone furnace which promises savings of half a million dollars in a 75,000-kw plant.

A survey of the mineral fuel reserves of the United States showed that these can supplement the declining reserves of natural gas and petroleum for one to two thousand years.

A study showed that clogging of bituminous coal in bunkers

D. Robert Yarnall

Retiring President of
The American Society
of
Mechanical Engineers
for 1946

is due to critical moisture content and not to design of bunker. Another paper described a new method for determining moisture in coal fed to a pulverizer from panel instruments.

A new type of failure in a boiler tube of a 1350-psi boiler which showed up after seven years of successful operation was described. The failure, attributed to corrosion and embrittlement, showed up as a 1-in-diam hole blown out of the tube.

According to a progress report by the Locomotive Development Committee of the Bituminous Coal Research, Inc., two full-scale gas turbines have been ordered and may be under test within 18 months.

Several papers reported on graphitization studies of high-temperature welded piping and the influence of postweld heat-treatment on graphitization.

The first technical exposition anywhere of gas-turbine advancements made by Brown, Boveri and Company, Limited, Baden, Switzerland was given by Dr. Adolf Meyer, member A.S.M.E., a few hours before he sailed for Europe. He described the comprex (called by engineers in the audience the most significant contribution to gas-turbine development in recent years), a 27,000-kw gas turbine, and a supercharger for a wood-burning gas-turbine locomotive.

Design data and initial operating experience of the 2000-hp Westinghouse gas-turbine generator set was announced.

Navy studies of the German wartime application of hydrogen peroxide for submarine propulsive power were reported.

A historical account of the timely application of high-temperature and high-pressure steam to Navy combat ships, as well as the design problems which had to be solved, were reported at the Marine Power Session.

AVIATION ROCKETS

At joint sessions of the Oil and Gas Power and the Aviation Divisions of the A.S.M.E. with the American Rocket Society it was revealed that a multiple-cylinder rocket engine has been developed by Reaction Motors, Inc., to power a recently built transonic research airplane. The new airplane is to make its first flights in the near future. The motor, which weighs only 210 lb, is said to be able to develop 12,500 hp at the speed of sound. It is reported to attain with high efficiency any thrust from less than 1000 lb to more than 6000 lb. The propellants used are liquid oxygen and alcohol.

An atomic-energy rocket motor was also foreseen at the meeting, possibly to propel space ships which can either establish an

PRESIDENT YARNALL PRESENTS NORMAN R. GIBSON WITH THE HOLLEY MEDAL

orbit around the earth or leave the earth entirely for the moon or planets.

Other applications of rocket power in aviation foreseen included jet decelerator units to bring aircraft to a quick stop on runways, and stand-by jet motors for extra power aloft. Jet units now are being developed for light airplanes, both for take-off assistance and to provide emergency power for gliding in case of engine failure.

Guided missiles, including pilotless aircraft, were reported to be capable of replacing or complementing all guns except infantry-borne arms.

It was revealed that antiaircraft guns and 16-in. rifles on battleships may soon be replaced by guided missiles. In the future, aircraft will carry both offensive and defensive guided missiles. Cities will be protected by batteries of them.

Commercial peacetime applications of rocket power, including jet assist units for trucks and trains as well as for aircraft work, were forecast.

The adoption of rocket power to industrial and emergency uses such as opening or closing flood gates, drawbridges, and fire barriers were reported to be under study.

RAILROADS

A symposium covering the designing of Diesel road locomotives and a forum on weight reduction in passenger-car equipment and specialities highlighted the Railroad Division's program this year.

It was pointed out that there was a need for changes in, and standardization of, electrical equipment. Changes in the design of chassis and running gear were considered. Under accessories, the design of the various equipment such as air brakes, train-control equipment, couplers, fuel and water tanks, the standardization of communication systems, and train heating was discussed. Such factors as lubrication, cooling, accessibility, and maintenance were also considered.

An effort toward reducing further the weight of accessories such as air-brake equipment, heating apparatus, underframe and truck castings, air-conditioning equipment, roller bearings, etc., is now being made, according to the passenger-car weight-reduction forum that was held.

The annual progress report on railway mechanical engineering was also presented at the meeting. Many new developments and the many new Diesel-electric locomotives built during the year were cited. Outstanding was the development of a coal-burning gas-turbine locomotive.

RUBBER AND PLASTICS

An interesting paper describing the laboratory testing of rubber torsion springs was presented at one of the Rubber and Plastics technical sessions. It revealed that tests have been performed to establish the load deflection modulus, creep, and fatigue properties of these springs. Work has also been done to a limited degree to investigate the effect of temperature on these properties.

Precision molding of plastics to tolerances of plus or minus 0.0015 in. was revealed to be possible if careful consideration were given to such factors as mold construction, moisture content, uniformity of materials, preheating, length of curing time, speed, and pressure of transfer rams and postconditioning of molded parts.

The comparison of creep data for wood-flour-filled phenolic and cellulose-filled melamine plastic indicated that the two materials exhibit essentially the same characteristics. Long-time tensile strength of cellulose-filled melamine was revealed to be superior to that of wood-flour-filled phenolic material. Dynamic flexural-fatigue tests indicated that wood-flour-filled phenolic plastic is superior to melamine.

Papers outlining the significant developments and advances in rubber and plastics were also presented at the sessions.

MANAGEMENT

The first session of the Management Division, held on Monday evening, taxed the capacity of the Keystone Room of the Pennsylvania Hotel. The session took the form of a panel discussion of the subject, "A Basic National Labor Policy." The speakers for management were Herman W. Steinkraus, president, Bridgeport Brass Co., and Lee H. Hill, publisher, *Electrical World*. Speakers for labor were Clinton Golden, adviser and consultant, United Steel Workers of America, C.I.O., and Frank Fenton, director of organization, American Federation of Labor. W. H. Davis, formerly chairman, National War Labor Board, presided.

On Tuesday the Division turned its attention to real wages and higher productivity; and that afternoon Harold G. Moulton, president, the Brookings Institution, Washington, D. C., spoke on pricing policies and social trends. This address was followed by a panel discussion. The Wednesday morning session of the Division was devoted to discussion of the conservation of industrial raw materials.

CITIZENSHIP SESSION

On Tuesday morning, December 3, the theme of the 1946 Meeting was further explored at the Citizenship Session sponsored by the Committee on Engineers' Civic Responsibilities.

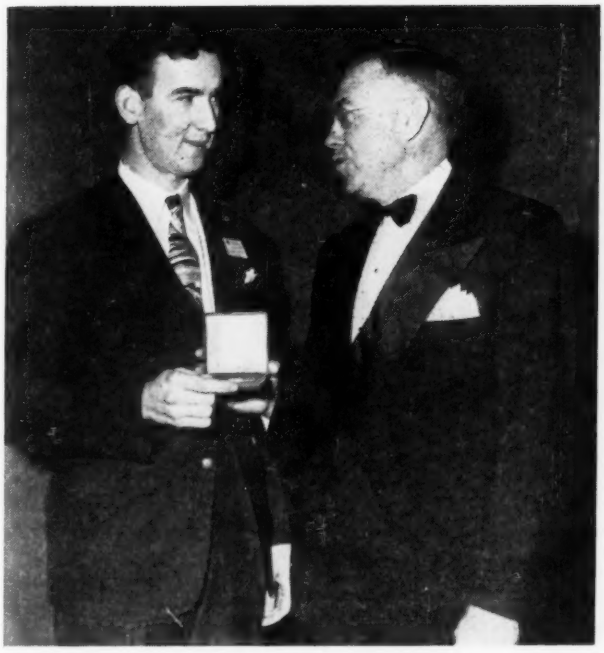
A small but select group of industrialists and educators heard Roy V. Wright, chairman, review the fund of ideas contributed by the speakers and discussion of the Keynote Session. Acting upon the suggestion of Frank H. Neely, member A.S.M.E., vice-president, Rich's Inc., Atlanta, Ga., that top management encourage younger engineers in the pursuit of civic responsibility by allotting time during business hours for this activity,

it was agreed that Dr. Lillian M. Gilbreth, fellow A.S.M.E., be delegated to present this idea to the Management Division for their consideration.

Among those who contributed to the discussion were: Dugald C. Jackson, honorary member, A.S.M.E., professor-emeritus, electrical engineering, M.I.T.; Webster N. Jones, director, College of Engineering and Science, Carnegie Institute of Technology; S. E. Winston, member A.S.M.E., professor of mechanical engineering, Illinois Institute of Technology, Chicago, Ill.; E. B. Smith, member A.S.M.E., professor of mechanical engineering, College of the City of New York; and F. A. Faville, member A.S.M.E., president, Faville-Le Vally Corporation, Chicago, Ill.

DISCUSSION OF INGENUITY

The Committee on Education and Training for the Industries continued its discussions of ingenuity and how to develop it, a subject which has had a major place on the programs of A.S.M.E. Annual Meetings for several years. On Tuesday afternoon the topic was the responsibility of industry in the development of ingenuity. On Wednesday afternoon the committee turned its attention to the engineer's need for commercial imagination; and on Thursday afternoon it considered ingenuity in production engineering.



PRESIDENT-ELECT O'BRIEN PRESENTS VICTOR S. RYKWALDER WITH THE CHARLES T. MAIN AWARD

III—COUNCIL MEETS WITH COMMITTEES

SECRETARY DAVIES SPEAKS ON ORGANIZING THE ENGINEERING PROFESSION

In accordance with a practice of several years' standing, Sunday evening at the 1946 A.S.M.E. Annual Meeting was devoted to a joint conference of the Council, professional divisions, and committees. President Yarnall presided, and C. E. Davies, Secretary of the Society, was the principal speaker.

Mr. Davies distributed copies of a paper entitled, "Organizations of Engineers in the United States of America," which he had presented at the International Technical Congress that was held in Paris, Sept. 16–21, 1946. He reviewed briefly the high lights of this paper in order to provide a background of fact as to what has been done to co-ordinate the activities of engineering organizations in the United States. In this paper, which will be found in this issue, pages 21–25, Mr Davies lists six responsibilities of the engineering profession and the related society purposes which support these responsibilities. In his talk on Sunday evening, Mr. Davies directed particular attention to the fourth and sixth of the primary responsibilities he had listed.

In discussing the fourth responsibility, "to increase the usefulness of the engineering profession," Mr. Davies cited the activities of the American Society of Civil Engineers in collective bargaining and read excerpts from a report on the status of these activities, an A.S.C.E. report on an interim classification and compensation plan, and an A.S.C.E. report on the earnings of engineering employees of Los Angeles County. He also referred to the collective-bargaining manual developed by the American Institute of Electrical Engineers, a project now taken over by a committee of the Engineers Joint Council; and he outlined briefly the E.J.C. program on economic-status survey, which consists of three major projects: (1) A survey and report of earnings of engineers with relation to education, years in practice, and field of specialization; (2) a survey of industry to determine company policies pertaining to the selection, training, placement, advancement, and professional activities of graduate-engineer employees; and (3) a survey on the problem of collective bargaining as it affects or may affect engineers in professional work and in training for professional work.

THE PUBLIC INTEREST

In discussing the sixth responsibility, "to minister to the public interest," Mr. Davies said that he was speaking largely in terms of the relations of engineering societies with the federal government. In this connection he mentioned the efforts of E.J.C. to express its views on bills in the 79th Congress looking toward the organization of a National Science Foundation and its attempts to see to it that a Division of Engineering was set up in the Atomic Energy Commission. The bills on the National Science Foundation had lapsed, but there was a possibility that some form of legislation would be considered by the 80th Congress. As to the Engineering Division, it had been incorporated in the Atomic Energy Commission.

Mr. Davies referred to the fact that the National Society of Professional Engineers maintained an office in Washington and that the A.S.C.E. had a representative there. In both of these cases, however, primary concern was with proposed legislation affecting engineers. What was lacking, Mr. Davies pointed out, was an effective means of co-operation between engineers and many important government agencies. It was this lack, he thought, that had lead A. B. Stickney, in an article in MECHANICAL ENGINEERING, April, 1946, to call for a "spokesman" for engineers and to propose a form of organization by which such a spokesman could be established.

An E.J.C. Committee on Engineering Organization, under the chairmanship of N. E. Funk, had been considering a report on local councils of engineers, Mr. Davies said, on the theory that specialists in engineering in a local community have a much better chance to co-operate effectively than in nation-wide groups. The report encouraged the formation of more councils.

ENGINEERING SOCIETY ORGANIZATION

With the aid of charts, Mr. Davies explained the four plans

New Members of the 1947 A.S.M.E. Council

Regional Vice-Presidents

LINN HELANDER

T. S. MC EWAN

EDWARD E. WILLIAMS

N. E. FUNK

ALTON C. CHICK

A. R. MUMFORD

of engineering-society organization which the A.I.E.E. had proposed for discussion by its members. Plan A contemplated a bringing together of all technical societies in the electrical-engineering field into a single society. Plan B proposed that the national societies (A.S.M.E., A.I.E.E., etc.) surrender some of their "nontechnical" activities to the N.S.P.E. and that the individual engineer join both the N.S.P.E. and the technical society representing his field of interest. Plan C, based on a "council" form of organization, had as the over-all group the Federated Engineering Societies. Plan D called for an American Society of Engineers, under which would exist the national technical societies, state societies, and certain "national nontechnical committees" which would, presumably, deal with matters of concern to all engineers.

Mr. Davies discussed these various plans and said that a canvass of preferences of 422 members of A.I.E.E. gave the first choices in the following order: D, C, B, and A; and second choices, C, B, D, and A.

W. F. RYAN APPEALS FOR THE SPIRIT OF SERVICE

At the close of Mr. Davies' talk, W. F. Ryan, of Boston, spoke in support of plan B. Mr. Ryan said that the basis of any profession was service to humanity. If engineers could be made to understand that in a profession, obligations came before prerogatives, the questions of organization and recognition would take care of themselves. It was necessary, he insisted, that engineers should first make certain distinctions clear in their own minds. The individual engineer must first recognize himself as an engineer. Just as he seeks a diploma as evidence of the completion of his engineering education, so also he should seek registration as evidence of his competence to practice. Mr. Ryan expressed the conviction that a federation of engineering societies would not be effective. It would be necessary, he asserted, for the engineering societies to give up some of their sovereignty. Neither E.J.C. nor E.C.P.D., he said, could do anything without the approval of the sovereign societies of which they were made up.

Nevin E. Funk described the organization of the American Medical Association. He disagreed with Mr. Ryan on the ineffectiveness of a federation of societies. A federation, he insisted, had the advantage that its component societies could act without coming to a unanimous agreement. With a single society, however, no action could be taken without majority approval, and the persons acting for the society would be just as likely to have different opinions as they would have if representing their constituents on E.J.C. or E.C.P.D.

It was Mr. Funk's opinion that movement toward unified society organization should be made slowly. Because of the existence of local councils, progress was more rapid than it had been in the past. Through the council, engineers would build

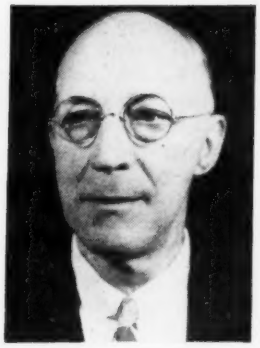
New Members of the 1947 A.S.M.E. Council

Directors at Large

L. K. SILLCOX

W. A. CARTER

F. S. BLACKALL, JR.



L. F. MOODY

from the bottom up—from local, through state, to national levels of influence.

Leonard J. Fletcher, of Peoria, Thomas S. McEwan, of Chicago, and President Yarnall also contributed to the discussion.

ACTIVITIES OF THE A.S.M.E. COUNCIL

During the 1946 A.S.M.E. Annual Meeting the Council of The American Society of Mechanical Engineers met on several occasions. D. Robert Yarnall, president, presided at all sessions.

At the first session, held on Sunday afternoon, Dec. 1, the following actions of general interest were taken:

VICE-PRESIDENT, REGION III

Nevin E. Funk, of Philadelphia, was selected by the Council to serve as vice-president, to December, 1947, to fill the vacancy in Region III caused by the death of A. R. Stevenson, Jr.

ANNUAL REPORTS

The Secretary presented the annual reports of the Council and Committees which had been distributed by mail and the Council voted to adopt these reports. The report of the Council and of the Finance Committee will be found on pages 41–52 of this issue. The reports of committees are separately printed and may be had on request to the Secretary's office.

The Secretary presented the annual report of the Woman's Auxiliary to The American Society of Mechanical Engineers, which the Council voted to receive with expressions of felicitation and appreciation.

BOARD ON TECHNOLOGY

R. F. Gagg, chairman of the Board on Technology, presented the recommendation of the Board that the Council adopt the following statement of policy covering A.S.M.E. participation in educational exhibits:

"The Society may engage in or ally itself with such exhibition activities as are of professional interest and usefulness to the membership of the A.S.M.E. Exhibits shall be within the field of one or more of the professional divisions of the Society. Exhibits shall normally be planned to be a supplement to the technical program and shall not unduly interfere with the operation of any meeting or activity of the Society. They shall be self-supporting. General supervision of exhibit activities shall be in the field of the Board on Technology."

The Council voted to approve this statement of policy, which supersedes one adopted in June, 1942.

MEMBERSHIP DEVELOPMENT

A statement, "Membership Development Guide," issued by the Committee on Membership Development, was received by the Council.

BOARD ON CODES AND STANDARDS

A statement of procedures of the Board on Codes and Standards was adopted by the Council.

MONDAY SESSION OF THE COUNCIL

At the Monday session of the Council Mr. Davies introduced Dr. J. J. Cermak of the University of Prague, Czechoslovakia, who was visiting the United States to complete his knowledge of the developments in steam boilers. In addition to his duties at the University, Dr. Cermak is chief of the boiler-design department of the Skoda Works.

DEATH OF E. G. BUDD

President Yarnall announced with regret the death, on Nov. 30, 1946, of Edward G. Budd, of Philadelphia, member A.S.M.E., and A.S.M.E. Medalist, 1944.

BY-LAWS AMENDED

Revisions and amendments to the By-Laws and Rules of the Society, presented for first reading at the Council meeting in Detroit in June, 1946, were approved by the Council. Many of the amendments were made necessary by the changes in Society organization which are being put into effect. It is hoped that an explanation of these changes and the By-Laws amendments will be ready for publication in an early issue of MECHANICAL ENGINEERING.

ECONOMIC STATUS

Mr. Davies reported a meeting of members of the Executive Committee and the Joint Committee on Economic Status, held on Sunday evening, Dec. 1, 1946, at which certain recommendations were drawn up to strengthen the Society's program on

behalf of young engineers. The recommendations, which were approved by the Council with the statement that they should be "implemented as rapidly as possible," follow:

1 That the Council set up a committee of five working members under the direction of the Board of Education and Professional Status which shall: (*a*) develop opportunities of the junior engineer in the engineering society and in industry; (*b*) interpret the survey reports flowing from the Joint Committee on Economic Status of the Engineer and recommend proper Society action; and (*c*) maintain contact with the current activities of the Joint Committee on Economic Status so that from the personnel of this committee full representation can be provided at meetings and other activities of the Joint Committee. In the personnel of this committee, two, and preferably three, should be men of less than ten years' experience who are intimately acquainted with the aspirations of the engineer in training.

2 That the vice-presidents ask the sections to organize their efforts to welcome young engineering graduates and develop an obligation on the part of older men to be available to advise the youngsters.

3 That E.C.P.D. speed its efforts to formulate a thorough postgraduate college-training program.

4 That the Education Committee take immediate steps to start immediately a procedure of orientation training and education for the engineering graduate.

5 That the Secretary's office be directed to develop better methods of tracing the graduate from his engineering school to his first job and advising the sections of his coming, and to report the cost of following these methods.

HEADQUARTERS STAFF

In accordance with a recently established practice, the Secretary presented to the Council four members of his staff who had served it twenty-five years or more. These were: Ernest Hartford, executive assistant secretary, 35 years' service; Miss Jean Brown, whose work is with student-branch activities, 30 years' service; and Miss I. L. Martin, membership and admissions, and Mrs. G. S. Wood, professional divisions, 25 years' service. Miss Katherine Kemmer, of the addressograph department, who has also served the Society for 25 years, was unable to be present because of illness.

W. A. Hanley, past-president A.S.M.E., presented a resolution of thanks and appreciation which the Council passed, and President Yarnall handed each of the four members a check.

Mr. Davies then introduced to the Council new members of the staff, as follows: Walter Letroadec (personnel), P. Howard Sullivan (standards and safety codes), General S. E. Reimel (international relations), O. B. Schier, II, (professional divisions), R. L. Tedrow (assistant to the Secretary), Thornton Currier (boiler code), and Robert A. O'Brien (research).

1947 ANNUAL MEETING

At the conclusion of the session there was a discussion of the advantages and disadvantages of holding the 1947 A.S.M.E. Annual Meeting at Atlantic City instead of New York. It was pointed out that growth of the Society had taxed the capacity of New York hotels and the alternatives were to take the meeting to Atlantic City or to reduce drastically the number of sessions and technical papers. Opportunity for members of the Society to express their opinions on the place of the 1947 meeting was afforded by balloting throughout the week. The decision will be made by the 1947 Council.

1947 EXECUTIVE COMMITTEE

On Monday evening members of the 1946 and 1947 Councils met together and the 1947 Council was organized. The Executive Committee of the 1947 Council will be made up of the following members: E. W. O'Brien, chairman, Alton C. Chick, A. R. Mumford, J. N. Landis, and F. S. Blackall, Jr.

ANNUAL BUSINESS MEETING

The 1946 Annual Business Meeting of the A.S.M.E. was held on Monday afternoon, December 2, at the Hotel Pennsylvania; President Yarnall presided.

The reports of the Council and Finance Committee (see pages 41–52 of this issue), certain material required by law to be filed, and the reports of the committees to the Council were presented. Approval, confirmation, and ratification of all actions of the Council and officers during the year was voted.

The Secretary read the report of the tellers of election of officers for 1946–1947 and the officers were declared elected to take office at the close of the 1946 Annual Meeting. It was announced that the 1947 Council will select a director at large to fill the vacancy caused by the death of B.V.E. Nordberg. The officers elected are: President, Eugene W. O'Brien; regional vice-presidents, Alton C. Chick, A. R. Mumford, E. E. Williams, T. S. McEwan, Linn Helander; directors at large, F. S. Blackall, Jr., L. F. Moody, W. A. Carter.

L. K. Sillcox was appointed director at large to fill the vacancy caused by the death of B. V. E. Nordberg.

DAVIES REPORTS ON HIS MISSION TO EUROPE

At the request of the President, C. E. Davies, Secretary of the Society, reported on his mission to England and France in September, 1946. Mr. Davies said that his mission had been authorized by the Council. He spoke briefly of conditions as he found them in the countries he visited. One of the purposes of the mission, he said, was to engage in further discussion on the international standards on screw threads. W. L. Batt and H. T. Woolson accompanied Mr. Davies to take part in this phase of the mission. Mr. Woolson devoted much time to the technical discussions and progress was made, Mr. Davies reported. However, later in the fall, another mission of four headed by F. S. Blackall, newly elected director at large, visited England to work out further agreements on thread gaging.

Mr. Davies said that he had spent much time in London with Dr. H. L. Guy, secretary of The Institution of Mechanical Engineers. He reported that the I.M.E. was growing rapidly and had a membership of 23,340, of which 4000 were student members. During the past two years the I.M.E. had raised its admission standards. Rigid examinations are required by I.M.E. for admission to the associate-member grade. Because the I.M.E. operates under a royal charter, members are permitted to call themselves "chartered engineers," a designation which takes the place of registered engineer in this country and obviates the need for registration of engineers in England.

The I.M.E., Mr. Davies reported, was preparing for its centennial celebration in 1947 and the A.S.M.E. was contributing five speakers for this occasion. He had found great interest on the part of the I.M.E. in the work of the A.S.M.E. Gas Engine Co-Ordinating Committee, and it was expected that I.M.E. would be represented on that Committee by a corresponding member and that the A.S.M.E. would name a representative to the I.M.E. Gas Turbine Panel.

Mr. Davies said that he had also talked with the secretaries of The Institution of Civil Engineers and The Institution of Electrical Engineers.

Turning to the Paris phase of his mission, Mr. Davies described briefly the Sixth International Congress for Applied Mechanics (a report on which will be found in the December, 1946, issue, page 1097) and the International Technical Congress, which he had described in an article in the November, 1946, issue, pages 977 and 978.

As a result of the International Technical Congress at which a desire for some form of continuing organization was expressed, a World Engineering Conference was suggested. This Conference should prove to be a focal point for co-ordination of international engineering relationships and a means of contact with UNESCO (United National Educational Scientific and Cultural Organization) whose headquarters are in Paris. Mr. Davies said that he had spent some time in discussing the problems of engineering with UNESCO, on which engineering representation and influence were in a minority. In his opinion the engineering representatives were in need of help, support, and guidance, which could be offered them if there was to be an active group in Paris.

Engineers in Europe, he said, were interested to know when the United States was going to experience a depression and how long it would be before this country would once again become isolationist in spirit. The effect of either or both of these possibilities greatly concerned engineers in Europe, he said.

Although the World Engineering Conference might meet with some criticism in certain countries, it was Mr. Davies' opinion that this should not greatly concern us if we were to take our part in the Conference seriously. In his opinion American engineers had a stake in the problems of engineers in other countries. He suggested that American engineers should go to Europe so that European engineers could learn how we think. There was a parallel here with the United Nations. It was necessary, he said, to make things work, to get acquainted, by means of some inexpensive and direct method of co-ordinating engineers throughout the world, such as the Conference, in a manner which would show that the United States was a part of the world and desired to keep the world at peace.

RESOLUTIONS ON UNIONIZATION

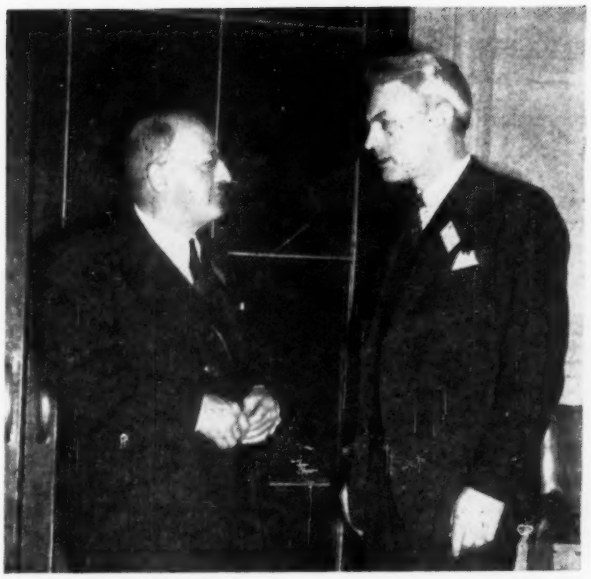
A. A. Bato, member of the Society, presented two resolutions which were received and referred to the Council. The first resolution proposed a questionnaire on unionism to be sent to A.S.M.E. members and a committee to evaluate the replies. The second resolution encouraged the holding of meetings on unionization in all A.S.M.E. sections, the collection of member opinion, and the appointment of a central committee to receive and evaluate members' views and to work out procedures suggested by these views.

IV—LUNCHEONS AND DINNERS

KEYNOTE LUNCHEON

As the keynote speaker of the 1946 Annual Meeting, Carl Hinshaw, Congressman from California, sounded the call for more engineers in city councils, state legislatures, and in the Congress of the United States, so that their talents, which he called "a unique synthesis of the theoretical and the practical," could find expression in the direct service of the people. He spoke on "The Public Responsibility of Engineers" at the Keynote Luncheon, Monday, December 2, before 250 members and guests who also heard distinguished A.S.M.E. members tell of actual projects in which engineers have taken the initiative and rendered significant community service.

ROY V. WRIGHT (*left*) AND CONGRESSMAN CARL HINSHAW (*right*)



DR. ADOLF MEYER (*left*) AND R. TOM SAWYER (*right*) AT AN OIL AND GAS POWER SESSION

D. Robert Yarnall, president A.S.M.E., opened the meeting by paying tribute to the chairman of the luncheon, Roy V. Wright, past-president and honorary member A.S.M.E., whose work on the A.S.M.E. Committee on Engineers' Civic Responsibilities since its organization in 1933 culminated in the Keynote of the 1946 Annual Meeting.

Before introducing Congressman Hinshaw, Mr. Wright spoke briefly about his experiences as a senator in the legislature of New Jersey. He said that legislatures are influenced by the citizens and lean heavily on information supplied by them. Instead of "letting George do it," Mr. Wright urged engineers to assume responsibility for legislation by giving facts to their representatives. More effective still, he said, was the presence of professional men in legislative bodies where their straight thinking and analytical powers could help to keep legislation on the right track.

Congressman Hinshaw called the present "an exceedingly critical juncture in the history of the world" and one in which that practical theoretician, the engineer, must take the lead everywhere.

"Let us not mince words," he said, "but speak the truth. Those who would lead us to the left draw a picture of a life that few persons now outside of the Soviet Union have ever seen. It is an enticing picture of the planned economy with full employment and a fair share of the products of that employment. Those Americans who have experienced the life in Russia as erstwhile ardent advocates of that system and who have been able to escape from it to return here, have been cured by their experience. Engineers who have gone to render professional service under contract have returned cured of any leanings they may have had. It is the economy of an enormous

prison. Any good penitentiary provides full employment and the maximum of security to its inmates."

Engineers who have built the great machinery-manufacturing and the mass-production industries that employ millions of workers, are responsible for the high American standard of living. Engineers have the basic information. They must translate it into the simple truth that everyone can understand—that more production means more real wages.

The public responsibility of the engineer in an age created by engineers is to teach people the truth and the basic facts about that age. The people must unlearn the false theories of the past few years and learn that it is greater production per hour that makes abundance at lower cost and makes pay checks worth more to them and their families.

The complete text of Congressman Hinshaw's address will be found on pages 13–15 of this issue.

CONTRIBUTION TO CIVIC MANAGEMENT

Harold V. Coes, past-president A.S.M.E., told the luncheon guests how the Montclair Society of Engineers, Montclair, N. J., has assisted the town administration. He cited ten instances of service as typical of those the Montclair Society was called upon to render. Among these were: A study of and recommendations on specific street and vehicular traffic problems; recommendation of a certain water-supply engineer to make an exhaustive survey of the town water supply; and substantiation of a report by the town engineer on a new scheme for charging for sanitary-sewer service.

ENGINEERS' ACTIVITIES IN DETROIT

Samuel M. Dean, chief engineer, The Detroit Edison Company, Detroit, Mich., said that local engineering societies are effective because they call on a wide range of engineering talents to direct mature judgment on technical problems and because as technical men they have no political axe to grind. Speaking about the attitude of legislators to the service offered by engineers, he said that such service is welcomed when purely technical matters are involved but that when engineers touch on broader subjects they must expect their opinions to be challenged or pigeonholed by administrations who may not like them.

Mr. Dean related how the Detroit engineers saved the city large sums of money by correcting a garbage-disposal system. When citizens in the vicinity of the incinerators complained about odor and smoke and brought an injunction against the city, engineers studied the equipment, recommended modifications to the installations, changed the operating procedure, and by these means were able to settle the problem out of court.

Other studies on airport location saved the city 10 to 15 million dollars which would have been spent on an airport originally planned by the city authorities.

Finally, he related how Detroit engineers, after a study of the transportation problem of the city, caused the question to be reconsidered with the result that a plan to meet the long-time needs of the city is in the making.

REGIONAL TRAINING

E. E. Williams, vice-president, A.S.M.E. Region IV, said that the theme of civic responsibility should be carried to student and junior members of the Society by means of regional meetings which could be attended conveniently by younger engineers. Since 70 per cent of the members do not attend national meetings, regional meetings near home at which general programs are featured would give young men the opportunity to express themselves and benefit from such experience.

A COMMUNITY PROGRAM

Leonard J. Fletcher, member A.S.M.E., director of training and public relations, Caterpillar Tractor Company, Peoria, Ill., called on engineers to "water-down" the destructive forces of misunderstanding in the world today by "swapping ideas" between the members of their own communities who have divergent views of the great questions of the day. As a basic unit of the nation, problems can be solved on a community basis, which, if neglected, will cause misunderstandings more dangerous than the atom bomb.

Mr. Fletcher had a method to suggest for swapping ideas. He asked members to accept the responsibility for organizing discussion groups of representatives of business, labor, and education in their community. He suggested a group of less than fifty who could meet for dinner primarily to learn what other people were thinking and why. Good listening is the key to swapping ideas, Mr. Fletcher said, but this must be supported by genuine friendliness and a sincere desire to know the other man's views.

I.I.R. DIVISION DINNER

One hundred members and guests of the I.I.R. Division were present for the annual dinner of the division on Monday, December 2, which formally closed the most active year of the division's history.

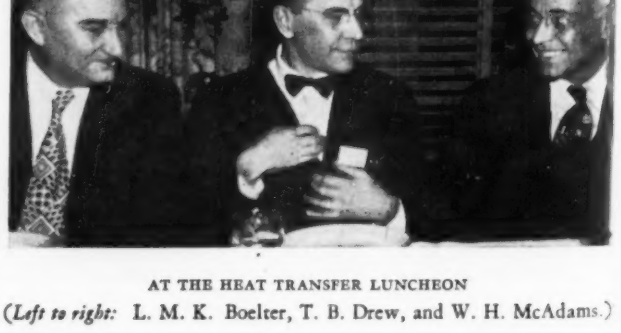
Ed S. Smith, retiring chairman and one of the founders of the division, reviewed the events of the past year and called attention to the success of the division's first national meeting in Pittsburgh, Pa. He introduced the new chairman, J. C. Peters, Leeds and Northrup Company, Philadelphia, Pa., and the subcommittee chairmen to whom the responsibility for division leadership was to pass.

E. D. Haigler, member A.S.M.E., Foxboro Company, Foxboro, Mass., presented an illustrated talk about his trip to Germany which was made to investigate German achievements in instrumentation. He demonstrated that the Germans, despite their pride and arrogance about their work, were not ahead of American practice.

HEAT TRANSFER LUNCHEON

Recent advances in the science of heat transfer were reviewed by L. M. K. Boelter, member A.S.M.E., dean, college of engineering, University of California, Los Angeles, Calif., in an address which he gave at the Heat Transfer Luncheon, Tuesday, December 3. A few of the advances of professional and scientific significance described by Dean Boelter were the following:

Analytical and empirical equations have been developed to describe the analogy between heat, mass, and momentum trans-



AT THE HEAT TRANSFER LUNCHEON
(*Left to right:* L. M. K. Boelter, T. B. Drew, and W. H. McAdams.)

fer mechanisms in various flow systems. By means of this analogy it is possible to predict heat and mass transfer characteristics for those systems in which momentum transfer (friction) data are available.

Several numerical and graphical techniques are now available to solve complex heat-conduction problems. It is possible to decrease the time required to accomplish these solutions if automatic calculating machinery is employed.

Important developments have been made in the construction of instruments to measure (1) rates of heat transfer and (2) fluid turbulence characteristics. These instruments include the heat meter, radiometer, hot-wire anemometer, and the air-gustiness meter.

W. S. Patterson, assistant manager, forced circulation boilers, Combustion Engineering Company, Inc., New York, N. Y., then delivered a resolution of appreciation to Dr. C. E. Lucke, Columbia University, New York, N. Y., for his long and tireless service in furthering the efforts of the Heat Transfer Division, and the profession as a whole.

Presiding at the luncheon was W. H. McAdams, professor, Massachusetts Institute of Technology, Cambridge, Mass. The guests were welcomed by T. B. Drew, member A.S.M.E., professor, chemical engineering, Columbia University, New York, N. Y.

MANAGEMENT LUNCHEON

At the Management Luncheon on Tuesday at which A. I. Peterson, chairman of the Management Division, presided, the address was delivered by Paul G. Hoffman, Gantt Medalist for 1946, and president of the Studebaker Corporation, South Bend, Ind. His subject was, "Outlook for Freedom."

Mr. Hoffman indulged in what he called "successful worrying" over some pressing national problems. His first worry was that of labor-management relations. In this area, he said, we must have a new set of ground rules controlling collective bargaining and there must be a change in attitude on the part of both management and labor.

The speaker's second worry concerned inflation. Mr. Hoffman listed four means by which this menace might be combated: (1) We must increase productivity; (2) both individuals and businesses should refrain from making deferable expenditures for the time being; (3) we should all support the campaign to sell series E and F bonds in small denominations; and (4) governments—national, state, and local—should quickly reduce expenditures and defer projects not urgently needed at the moment.

The third and last worry which Mr. Hoffman "shared" with his audience concerned the belief on the part of many persons that another major depression is inevitable. Instability in market demand, he pointed out, results from a complex set of factors, among which were: High standards of living; the large capital investments required for modern business; the credit system; the tax system; and the influence of foreign trade.

Mr. Hoffman discussed each of these factors, and suggested specific areas in which government should take prompt action to promote greater stability in our economy, as follows: (1) Our tax system must be revised to help counteract both inflation and deflation; (2) federal and local governments can help stabilize the economy through better timing of public works; and (3) our government should expand and consolidate unemployment-compensation coverage.

For making our economy more stable, Mr. Hoffman named three responsibilities of businessmen: (1) Profitable operation of their businesses; (2) regularization of employment in every business; and (3) exercise of the scientific control of sales expenditures.

CHARLES M. ALLEN (*left*) RECEIVES A BOOK OF TESTIMONIAL LETTERS FROM S. LOGAN KERR (*right*)

In conclusion, Mr. Hoffman said that he sincerely believed that during the next 25 years the progress we would make would be without parallel. "If we remain at peace," he said "the real income of most of our people can be doubled. We can also largely realize the age-old dream of abolishing poverty. Most important of all, on this material foundation we can build conditions which will provide not only equality of opportunity but certainty of opportunity for every man, woman, and child to grow and develop intellectually and spiritually."

At the close of the session Mr. Peterson, as retiring chairman, was given a certification of appreciation of his services to the Management Division, and John A. Willard was introduced as chairman of the division for 1947.

RAILROAD LUNCHEON

The annual Railroad Division luncheon held on Thursday was again highlighted by the presentation of fellowships in the A.S.M.E., awarded to men of the Railroad Division during the year. Those who received certificates of fellowship were: E. D. Campbell, vice-president, American Car and Foundry Company, New York, N. Y.; W. A. Newman, manager, research department, Canadian Pacific Railway, Montreal, Quebec, Canada; Ralph P. Johnson, chief engineer, Baldwin Locomotive Works, Philadelphia, Pa.; A. G. Trumbull, general mechanical engineer, Cleveland, Ohio; William M. Sheehan, vice-president, General Steel Castings Corporation, Eddystone, Pa.; F. H. Hardin, president, Association of Manufacturers of Chilled Car Wheels, New York, N. Y.; and Carlton D. Stewart, vice-president, Westinghouse Air Brake Company, Wilmerding, Pa.

D. Robert Yarnall, retiring president A.S.M.E., read the citations and presented the certificates.

WOOD INDUSTRIES DINNER

The Wood Industries Division held its annual dinner on Tuesday, December 3. It was followed by an informal business meeting at which the members discussed the organization of committees for 1947. A program for 1947 was also established. During this meeting Carl B. Lundstrom, member A.S.M.E., Standard Furniture Company, Herkimer, N. Y., was nominated for the chairmanship of the Wood Industries Division for 1947. A. C. Fegel, member A.S.M.E., manufacturing engineer, Western Electric Company, Inc., Kearny, N. J., the retiring chairman of the division, presided over the meeting.

HYDRAULICS OLD TIMERS' DINNER

Prof. Charles M. Allen, honorary member A.S.M.E., director, Alden Hydraulic Laboratory, Worcester Polytechnic Institute, Worcester, Mass., was among friends when he joined the group gathering for the Hydraulic Old Timers' Dinner, Tuesday, December 3. He was not allowed to sit at his table but was called to one end of the speakers' table. He had paid for his admission and was out to enjoy the associations won by more than fifty years as an engineer and teacher, he said.

S. Logan Kerr, member A.S.M.E., chairman, called the meeting to order and proposed that Tuesday of every A.S.M.E. Annual Meeting be set aside as Hydraulics Day, to be devoted to the program of the Hydraulic Division, followed by an annual dinner. The suggestion was accepted. Then he announced the formal program of the evening and what followed was the most heart-warming and hilarious evening of the Annual Meeting.

Stories were told, poetry was recited, and engineer after engineer paid tribute to a beloved engineer and friend—Charles M. Allen.

Professor Allen's broad grin dropped in disbelief when everyone rose to acknowledge him as the evening's honored guest, but in one moment he was up with a comeback.

"Not me! " he replied, "I've paid my way." He reached down for his wallet and brought out an old folded piece of paper.

"Sit down! sit down!" they urged from the floor. "Listen," he said in a biting pedagogical manner, "I'm the honored guest so you'd better listen."

He then proceeded to lay down the law on how an engineer should read a technical paper, and it became apparent why Professor Allen was a great teacher.

He spoke with a Yankee vernacular which was a delight to hear. Any engineer who needs notes "has no darned right to give a paper because he doesn't know his subject well enough," he said.

"Talk with enthusiasm," he lectured mockingly, "How in blazes can you interest anyone if you're not interested in the subject yourself?"

And of all the dumb things in his experience was an engineer speaking to a screen. "The darned thing doesn't understand English! "

The session was in an uproar. Professor Allen sat down satisfied, but others took his place to speak with affection about him.

They said that as a teacher, he was a master of Yankee ingenuity; a man who insisted on fundamentals; who used interesting methods in teaching; who propounded simple questions to test fundamental knowledge.

They said that as a boss, he was gifted with a genius for patience, an imagination for laying out work, and a flair for organization.

As a philosopher and friend, he had humor.

When the speeches were over, Professor Allen was presented with a book of testimonial letters.

To the friends who secretly planned this tribute, it must have been a great personal satisfaction to have watched the "Prof" gracefully shed compliments and to have heard him repeat some of his stories, but to guests who happened to attend for want of some other convenient event, it will remain a touch of fortune to have met so remarkable a man.

APPLIED MECHANICS DINNER

The annual dinner of the Applied Mechanics Division was held on Tuesday evening. H. Poritsky, chairman of the division, presided. He called on Hugh L. Dryden to tell about the Sixth International Congress for Applied Mechanics held in Paris in September, 1946, and on George A. Stetson, editor A.S.M.E., to tell about the new publication, *Applied Mechanics Reviews*, which the Society will publish as soon as arrangements can be completed. J. M. Lessells, editor of the *Journal of Applied Mechanics*, J. N. Goodier, past-chairman, and H. W. Emmons, secretary of the division, also spoke briefly.

The principal address of the evening was delivered by E. S. Lee, of the General Electric Company. Mr. Lee entertained his listeners for more than an hour with an amusing and informative account of his trip to Europe in September as representative of the A.I.E.E. to the International Technical Congress and the Sixth International Applied Mechanics Congress. Mr. Lee's description of conditions in England, France, and Belgium were acute and penetrating and his plea "There must be no more wars," was delivered with a sincerity based on profound conviction.

FUELS LUNCHEON

The atom bomb tests at Bikini atoll must be regarded as "the most widely misunderstood scientific experiment in all history," Philip W. Swain, member A.S.M.E., editor, *Power*, said at the Fuels Luncheon held Wednesday, December 4.

Asserting that Operation Crossroads was "brilliantly planned and managed," Mr. Swain said that the tests were conducted primarily to "get points on a set of curves," and that data so obtained were worth many times the expenditure. His discussion was based on his own observations at the Bikini tests, which he witnessed as official representative of the 25 McGraw-Hill publications. Newsreel movies of the tests were shown to illustrate the talk, which was on the subject: "What Really Happened at Bikini—an Engineer's Interpretation."

"After noting the 'small' number of ships sunk in Bikini tests 'Able' and 'Baker,' " said Mr. Swain, "the public and some of the observers felt a letdown. The bomb 'wasn't as powerful' as they had expected. Their basic mistake was in counting the number of ships sunk, as a measure of bomb effectiveness. By itself, this number means exactly nothing, just as the number of houses and people destroyed by an atomic-bomb burst overland means nothing unless you know the layout of the district."

Most persons have failed to recognize that the target arrays at Bikini were spread over 20 square miles, an average of more than 160 acres of open water per ship. Following the President's instructions, Admiral Blandy so disposed the target ships as to get "graded damage" ranging all the way from sinking to no damage.

"The undramatic truth is that the Bikini tests were conducted primarily to get points on a set of curves. The intelligent use of these curves by the men who build and operate the Navy will be worth many times the estimated $100,000,000 cost.

"If we can't get along without a Navy—and no one has yet shown how we can—the Navy must be designed to meet the actual conditions of an atomic age."

Asserting that "both Bikini tests were brilliantly planned and managed," Mr. Swain said that while the air-burst bomb missed the target ship *Nevada* by 1500 to 2000 ft, falling astern and slightly to port, "this will not greatly hamper the primary curve-plotting operation, based on the measured distance of ships from the actual burst."

ROCKET DINNER

On Thursday evening of the Annual Meeting a Rocket Dinner was held at the Hotel Pennsylvania under the auspices of the American Rocket Society. Dr. G. Edward Pendray, member A.S.M.E., acted as toastmaster. He introduced the guests at the speakers' table, among whom were Mrs. Robert H. Goddard, wife of the late Professor Goddard, "the Father of

As Seen by the Candid Camera at the 1946 A.S.M.E. Annual Meeting

PRESIDENT YARNALL PRESENTS MORRIS E. LEEDS WITH THE A.S.M.E. MEDAL

Rocketry; " Lovell Lawrence, Jr., president, and Roy Healey, vice-president, American Rocket Society; Harry F. Guggenheim, president of the Daniel and Florence Guggenheim Foundation; E. W. O'Brien, president-elect, A.S.M.E.; R. F. Gagg, vice-president, A.S.M.E.; and R. Tom Sawyer, chairman, A.S.M.E. Gas Turbine Co-Ordinating Committee.

Dr. Pendray announced that the American Rocket Society, although it had been in existence for 16 years, was holding its first national meeting. The occasion marked also the first anniversary of the affiliation of A.R.S. with A.S.M.E. The attendance at this first national meeting, Dr. Pendray said, was excellent, and the papers presented at the sessions sponsored by A.R.S. were well received. In his opinion the A.R.S. and its affiliation with A.S.M.E. were well launched. He explained that relationships between A.R.S. and A.S.M.E. were conducted by a committee of six members, three from each society. The representatives of A.R.S. on this committee were Lovell Lawrence, Jr., John Shesta, and himself; those representing A.S.M.E., were Mr. Sawyer, Mr. Gagg, and L. N. Rowley, Jr.

Alfred Africano, member A.S.M.E., senior project engineer, Curtiss-Wright Corporation, Caldwell, N. J., then took the chair and introduced the speaker of the evening, C. N. Hickman, research engineer, Bell Telephone Laboratories, Inc., New York, N. Y., whose subject was "Rocket Development for World War II." Dr. Hickman presented a historical account of work on rockets by Dr. Goddard and himself during World War I and said that the ending of the war had put an end to this development work before rocket motors had reached the stage of actual use in projectiles. However, much progress had been made during the interval between the two wars when research was financed by the Daniel and Florence Guggenheim Foundation. When World War II developed, research in rocket motors had been intensified under the research agencies of the government.

Into the brief period of his address Dr. Hickman condensed the principal factors of almost six years of intensive development. The address was illustrated with photographs and drawings of many types of rocket motors and rocket-propelled projectiles. High-speed motion pictures of rockets in flight and on static test stands were presented. These pictures had been taken by means of a camera developed by Dr. Hickman for the purpose of studying the flight of arrows, but first used in the rocket experiments.

In addition to the Rocket Dinner, the American Rocket Society co-sponsored three technical sessions and a luncheon with the A.S.M.E. It is understood that many of the research papers presented on these occasions will be published in the *Journal* of the American Rocket Society. Members of A.S.M.E. are eligible for membership in A.R.S.

COMMODORE WHITTLE SPEAKS ON TURBOJET ENGINES

The concluding luncheon of the 1946 A.S.M.E. Annual Meeting was held at the Hotel Pennsylvania on Friday noon with the American Rocket Society co-operating. Eugene W. O'Brien, president-elect of the Society, presided, and the address was delivered by Air Commodore Frank Whittle, R.A.F., to whom credit must be given for the development of the turbojet engine. Commodore Whittle was introduced by R. G. Standerwick, member A.S.M.E., engineer, Aircraft Gas-Turbine Division, General Electric Company, Lynn, Mass.

Mr. Standerwick described his first meeting with Commodore Whittle and how his identity had to be a carefully guarded secret. For three and one half months, he said, "Frank" had lived in his home without even Mrs. Standerwick's knowing who her guest was. Whittle's identity was first revealed to her when she heard the announcement of his presence in the United States over the radio when secrecy was no longer necessary. Mr. Standerwick told some amusing incidents of these months of Whittle's stay in his home and characterized him as the unquestioned inventor of the turbojet engine.

Commodore Whittle said that he considered it a great honor to be invited to address the A.S.M.E. His address, which was delivered extemporaneously and was illustrated with lantern slides, dealt with the development of the turbojet engine and jet-engined planes. At the conclusion of his address a short motion picture showing jet-engined planes in flight was exhibited.

In his comments, Commodore Whittle said that passengers in high-speed jet-engined planes of the near future would travel safely and economically. He pointed out some of the advantages of air travel in jet-propelled planes at 500–600 miles per hour, such as freedom from vibration and noise. At the high speeds obtainable by jet-engined planes, he said, air bumps do not disturb the airplane as they do at low speeds; and at the natural operating height of jet-airplane travel fewer bumps would be encountered in any event.

In spite of the great apparent noise outside a jet airplane, there is very little within, Commodore Whittle said. And there is so little vibration that it is sometimes necessary to attach vibrators to instrument panels so that instruments may be read.

Commodore Whittle listed the safety features offered by the jet-engined plane. Since low-grade fuels are used, fire hazards are reduced, he said. Moreover, the jet planes are easier to fly than the reciprocating-engine planes, and they reach their destinations so quickly that they get places before the weather experts have time to change their minds.

Reduced travel costs are another advantage of the jet plane, according to Commodore Whittle. Operating costs are cut down because the reduction of journey time makes possible a considerable saving in the provision of amenities.

"If the Queen Mary could cross the Atlantic in five hours, the swimming pool would hardly be necessary," he said.

According to estimates made by the De Havilland Aircraft Company, the cost per passenger mile of a 600-mile-per-hour jet airliner would be two thirds that of a conventional machine at 240 miles per hour.

Other factors contributing to the economy of jet travel are the low first cost of quantity production, the comparatively low weight, and the efficient use of fuel at high speeds, the Commodore stated.

In closing, Commodore Whittle said that high-speed travel would bring the peoples of the world closer together and this, in his opinion, would result in a greater degree of mutual understanding and should be a factor favoring world peace.

V—1400 ATTEND ANNUAL DINNER

The 67th Annual Dinner of the A.S.M.E. was held on December 4, in the ballroom of the Pennsylvania Hotel, against the backdrop of a gigantic American eagle which appropriately symbolized the theme of the A.S.M.E. 1946 Annual Meeting, "The Public Responsibility of the Engineer." Fourteen hundred guests were present to witness the impressive ceremonies during which the Society conferred honors and awards on distinguished engineers, paid tribute to the leadership of its senior members and officers, and rededicated itself to the service of the nation.

D. Robert Yarnall, retiring president A.S.M.E., was toastmaster. Seated with him on the dais were Eugene W. O'Brien, president-elect A.S.M.E., recipients of the 1946 honors and awards, and honored guests from Canada and Great Britain.

President Yarnall expressed regret that J. B. Hayes, president, The Engineering Institute of Canada, was unable to be present. He formally welcomed L. Austin Wright, secretary, E. I. C., and Sir Guy Garrod, British member of the United Nations Military Staff.

On the occasion of the Annual Meeting the Society pays tribute to members who, during the past year, had completed 50 years of membership in the A.S.M.E.

President Yarnall read the names of eleven members who now joined the Fifty-Year Members of the A.S.M.E., a distinction which was marked with a special medal. The list of 50-year members follows: Bancroft G. Braine, George A. Cutter, William M. Dollar, William Elmer, Sumner B. Ely, James E. Gibson, William S. Monroe, Albert L. Rohrer, James B Scott, Albert B. Tenney, and Arthur L. Williston.

Of these members, Mr. Williston was present and was asked to stand to receive the applause of the audience. President Yarnall explained that Mr. Williston received the 50-year medal of the Society at the 1946 Annual meeting in Boston, Mass., and that other members would have the medal presented to them in person at meetings throughout the coming year held in their own communities where they can be honored by their friends and neighbors.

PUBLIC RESPONSIBILITY

Referring to the theme of the Annual Meeting, President Yarnall reviewed his nation-wide travels in behalf of the Society and his conversations with engineers in all regions of the Society. It was his conclusion, he said, that engineers must elevate their sights to meet fully their responsibilities to the nation. An inner motivation is necessary, he pointed out, to drive engineers beyond the boundaries of their profession, compelling them to go the "second mile" so that they could use their engineering gifts in working with others for the good of the community.

The text of President Yarnall's address will be found on pages 5 and 6 of this issue.

PRESIDENT YARNALL PRESENTS MARTIN GOLAND WITH THE JUNIOR AWARD

MEDALS CONFERRED

President Yarnall turned next to the presentation of honors and awards. He called upon C. E. Davies, secretary A.S.M.E., to read the citations, and upon Charles M. Allen, fellow A.S.M.E., and Erik Oberg, fellow A.S.M.E., members of the A.S.M.E. Committee on Metals, to serve as marshals.

As the awards were announced, the marshals escorted the recipients to the center of the dais where the citation was read and each received from the president such certificate or medal as the award provided.

UNDERGRADUATE AND CHARLES T. MAIN AWARDS

President Yarnall announced that the following awards had been presented at the Members and Students Luncheon, held that noon, Wednesday.

The Undergraduate Student Award to PAUL A. THOMPSON, student member, A.S.M.E. for his paper, "Synthetic Sapphire—A New Industrial Engineering Material."

The Charles T. Main Award to VICTOR S. RYKWALDER for his paper, "Creative Engineering as a Factor in Promoting Full Employment."

Biographical sketches of the recipients of the Undergraduate Student Award and the Charles T. Main Award follow:

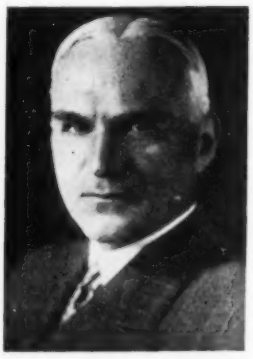
VICTOR S. RYKWALDER was born in River Rouge, Mich., in 1921. He entered the University of Detroit in 1939, but gave only part time to his college work during the war, while working for the Lee Engineering Company of Detroit, where he was advanced from a machine designer to the position of assistant chief draftsman in 1944 and 1945. He then devoted full time to his studies, securing his degree in 1946. He was elected student chairman of the student branch of the A.S.M.E. at the University during his senior year.

Mr. Rykwalder is employed at present by the Wyandotte Chemicals Corporation, of Wyandotte, Mich., as a mechanical engineer, engaged in steam-power study. He wins the Charles T. Main Award for his paper entitled "Creative Engineering as a Factor in Promoting Full Employment."

Recipients of Medals and Awards

MORRIS E. LEEDS
A.S.M.E. Medal

TROELS WARMING
Melville Medal



NORMAN R. GIBSON
Holley Medal

FRANK WHITTLE
Guggenheim Medal

VICTOR S. RYKWALDER
Main Award

MARTIN GOLAND
Junior Award

PAUL A. THOMPSON
Undergraduate Award

PAUL ALBERT THOMPSON, a junior at the Illinois Institute of Technology, is enrolled in the mechanical-engineering curriculum and is taking studies in the management option. He is business manager of *Technology News*, the student newspaper. The Undergraduate Student Award goes to him for his paper, "Synthetic Sapphire—A New Industrial Engineering Material."

Mr. Thompson, who has been a member of the A.S.M.E. student branch at the Institute for one year, was its representative at the Midwest Group Student Meeting held at the University of Notre Dame in April, 1946.

For three years prior to his enrollment at the Institute he worked in the Sapphire Products Division of the Elgin National Watch Company, the last year in its research department. He was also employed in the tool-design department of the Ford Motor Company at the Willow Run plant at Ypsilanti, Mich., for one year. He is twenty-five years old.

OTHER AWARDS

The recipients of the other awards were as follows:

MARTIN GOLAND, junior member, A.S.M.E., chairman, engineering-mechanics section, Midwest Research Institute, Kansas City, Mo., awarded the Junior Award for his paper, "The Flutter of a Uniform Cantilever Wing."

TROELS WARMING, junior member A.S.M.E., professor, University of Wisconsin, awarded the Melville Prize Medal for original work for his paper, "Polar Diagrams for Tuning of Exhaust Pipes."

NORMAN ROBERT GIBSON, member A.S.M.E., vice-president, Buffalo-Niagara Electric Corporation, Buffalo, N. Y., awarded the Holley Medal for 1946 "for achievements and inventions which have advanced the sciences of hydraulics and hydromechanics, including an original method of water measurement which made possible more accurate testing of large hydroelectric generating units."

MORRIS EVANS LEEDS, chairman of the board, Leeds and Northrup Company, Philadelphia, Pa., awarded the A.S.M.E. Medal for 1946 "for outstanding achievements in the invention and development of electrical- and temperature-measuring instruments and in the field of industrial relations."

BIOGRAPHICAL SKETCHES

Brief sketches of the achievements of the medalists follow:

MARTIN GOLAND, recipient of the Junior Award for 1946, was born in 1919 and received his engineering education at Cornell University. He remained at the University for two years as instructor in the mechanics of engineering before entering the employ of the Curtiss-Wright Corporation as section head of the applied-mechanics and the structures department at the Research Laboratory, Buffalo, N. Y. Since June, 1946, he has been chairman of the engineering-mechanics section, Midwest Research Institute, Kansas City, Mo. His paper, "The Flutter of a Uniform Cantilever Wing," published in the December, 1945, issue of the *Journal of Applied Mechanics*, won for him the Junior Award for 1946. Another paper, "The Influence of the Shape and Rigidity of an Elastic Inclusion on

Made Honorary Members of the A.S.M.E.

ALEXANDER G. CHRISTIE
Honorary Membership

RALPH E. FLANDERS
Honorary Membership

WILLIAM S. KNUDSEN
Honorary Membership

IRVING E. MOULTROP
Honorary Membership

LEWIS K. SILLCOX
Honorary Membership

the Transverse Flexure of Thin Plates," brought him the Spirit of St. Louis Junior Award two years ago.

TROELS WARMING, recipient of the Melville Prize Medal for original work for 1946, was born in Copenhagen, Denmark, in 1912. He received the master's degree in mechanical engineering from the Royal Technical College in 1936, and for three years was employed by Burmeister and Wain, Copenhagen, builders of Diesel engines. He came to the United States in 1939 to work for the Nordberg Manufacturing Company, Milwaukee, Wis., where his main responsibility was the calculation of the vibrations in the shaft systems of large marine Diesel engines. In 1945 he joined the Harnischfeger Corporation, Port Washington, Wis., where he worked on the development of a high-speed two-cycle Diesel engine. His prize-winning paper, "Polar Diagrams for Tuning of Exhaust Pipes," was published in the January, 1946, issue of A.S.M.E. Transactions.

NORMAN ROCKWELL GIBSON, recipient of the Holley Medal for 1946, was born in Canada in 1880. His engineering education was obtained at the University of Toronto, to which he returned after graduation to do postgraduate work in hydraulics and thermodynamics. For many years he was engaged in design and construction of hydroelectric power plants and distribution systems in the United States and Canada. He was closely associated with the development of electric power at Niagara Falls. He is now vice-president and member of the executive committee of the Buffalo Niagara Electric Corporation, Buffalo, N. Y.

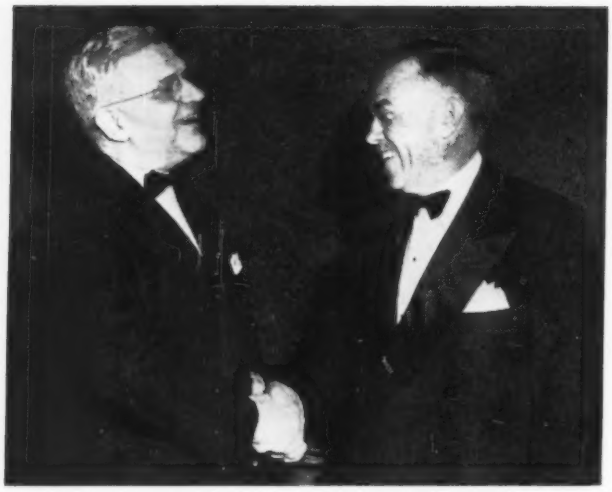
Mr. Gibson won widespread recognition for his method of flow measurement, which has been described as involving no empirical constants whatever and giving a result the mathematical accuracy of which is limited only by a relatively small instrumental and personal error involved in graphically recording and measuring the pressure wave. This method and apparatus for measuring the flow of water in closed conduits, a description of which was published in the A.S.M.E. Transactions for 1923, brought him the Elliott Cresson Gold Medal of The Franklin Institute in 1930.

MORRIS EVANS LEEDS, recipient of the A.S.M.E. Medal for 1946, was born in Philadelphia, Pa., in 1869. He studied at Haverford College and later at the University of Berlin, Germany.

For nine years he was in the employ of Queen and Company, manufacturers of physical apparatus and electrical measuring instruments. In 1899 he founded Morris E. Leeds and Company in Philadelphia, Pa., which four years later became the Leeds and Northrup Company.

Mr. Leeds was one of the founders of the Scientific Apparatus Makers of America and served as president of the association from 1920 to 1926. In 1920, for his invention of the Leeds and Northrup recorder, he received the Edward Longstreth Medal of Merit of The Franklin Institute. For his "achievement in industrial management as a service to the community," he was awarded the Henry Laurence Gantt Gold Medal in 1936.

During the depression of the 1930's, he worked in many ways for the promotion of national economic planning, social security, and better industrial relations. He was co-author of the book, "Toward Full Employment," published in 1938.



C. E. DAVIES (*left*) SECRETARY OF THE A.S.M.E., WELCOMES PRESIDENT-ELECT O'BRIEN TO OFFICE

For his pioneer work in the development of instruments based on the null method of electrical measurement, his patent on the Leeds mechanical relay electrical recorder and for his philosophy of management which includes employee stock ownership, profit sharing, and democracy in industry, he was presented with the A.S.M.E. Medal for 1946.

FIVE HONORARY MEMBERSHIPS CONFERRED

President Yarnall explained that because of the new Society policy of conferring certificates of honorary membership in the home communities of the recipients, three of the five honorary members elected in 1946 have already received the certificates of membership. He named the following:

LIEUTENANT GENERAL WILLIAM S. KNUDSEN, member of the board of directors, General Motors Corporation, Detroit, Mich., who was honored at the A.S.M.E. 1946 Semi-Annual Meeting in Detroit, Mich.

RALPH E. FLANDERS, fellow and past-president, A.S.M.E., president, Jones and Lamson Machine Company, Springfield, Vt., and United States Senator from Vermont, who was honored at the A.S.M.E. 1946 Fall Meeting in Boston, Mass.

IRVING E. MOULTROP, fellow and past vice-president, A.S.M.E., consulting engineer, Belmont, Mass., who was also honored at the A.S.M.E. 1946 Fall Meeting in Boston, Mass.

President Yarnall then proceeded with presentation of certificates of honorary memberships to the following:

ALEXANDER G. CHRISTIE, fellow and past-president A.S.M.E., professor of mechanical engineering, The Johns Hopkins University, Baltimore, Md.

LEWIS K. SILLCOX, fellow A.S.M.E., first vice-president, New York Air Brake Company, Watertown, N. Y.

A brief sketch of the achievements of the engineers thus honored follows:

WILLIAM S. KNUDSEN

William Signius Knudsen, whose exceptional talents and prodigious energy have made him one of the great production experts of the world, was born in Copenhagen, Denmark, in 1879. He came to the United States in 1900 and attained citizenship in 1914, During his connection with the Ford Motor Company he was production manager of the Model "T" cars and built three European assembly plants.

In 1922 he joined the General Motors Corporation in an advisory capacity and became its president in 1937. His influence on production is reflected in the increased motorcar and truck sales from 76,000 in 1921 to 1,180,000 in 1927.

During World War II he served as director general of the Office of Production Management and a member of the War Production Board. In this capacity he was elevated from civilian status to the rank of lieutenant general of the Army of the United States, an honor without precedent in our military history.

He was awarded the Distinguished Service Medal in 1944. A year later the Oak Leaf Cluster was added for his work as director of the Air Technical Service Command. He also holds the Grand Cross of Dannebrog, the highest civil decoration granted by Denmark.

He is now serving the General Motors Corporation as a member of the board of directors.

RALPH E. FLANDERS

Ralph Edward Flanders, whose parents could not afford to send him to college, holds eight honorary degrees and is regarded as a national authority of machine design and construction, especially on the engineering problems of screw design and thread grinding.

In 1912 at the age of 32 he entered the employ of Jones and Lamson Company, Springfield, Vt., and now serves as its president. Recently he was elected to the United States Senate by his native state.

His addresses before engineering organizations on current industrial and economic problems and his grasp of the factors underlying these problems led to his appointment to the N.R.A. Industrial Advisory Board, the Business Advisory and Planning Board of the U. S. Department of Commerce, the Economic Stabilization Board, and the Committee for Economic Development.

In New England he has brought improvements to industry and commerce as president of the New England Council and the Federal Reserve Bank of Boston.

He received the Worcester Reed Warner Medal of the A.S.M.E. in 1934 and served as president of the Society in 1935. He is also holder of the Hoover Medal.

IRVING E. MOULTROP

Irving Edwin Moultrop has long been recognized for his leadership in the installation of high-pressure steam-generating power equipment in this country and for long A.S.M.E. service.

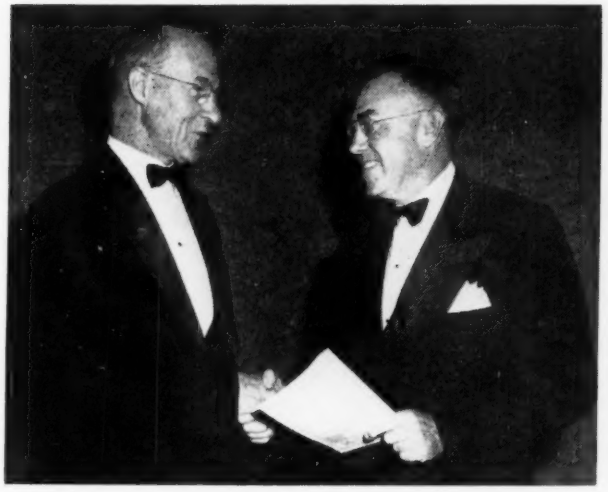
AT THE PRESIDENT'S RECEPTION

(*Left to right:* Mrs. Eugene W. O'Brien, Mrs. S. D. Moxley, Eugene W. O'Brien, Mrs. D. Robert Yarnall, D. Robert Yarnall, and S. R. Beitler.)

Mr. Moultrop was born in Massachusetts in 1865. After completing his high-school studies he was employed by the Whittier Machine Company, Boston, Mass. In 1892 he became associated with the Edison Electric Illuminating Company of Boston and served this organization until 1937. As chief engineer and superintendent of the construction bureau, he designed and installed many electric power stations, including the Edgar Station at Fore River, Mass., where steam pressures of 1200 psi were first commercially used.

As a member of the Society since 1902, he has served as manager and vice-president. He has done valuable work on committees of the A.S.M.E. and other societies dealing with prime movers, steam turbines, power test codes, and the Boiler Code. His international activities include the International Electrotechnical Commission and the World Power Conferences.

Mr. Moultrop holds the New England Award of the Engineering Societies of New England, the Elliott Cresson Gold Medal of The Franklin Institute, and the honorary degree of mechanical engineer from Stevens Institute of Technology.



PRESIDENT-ELECT O'BRIEN CONGRATULATES PAST-PRESIDENT A. G. CHRISTIE UPON HIS BEING MADE AN HONORARY MEMBER OF THE A.S.M.E.

ALEXANDER G. CHRISTIE

Alexander Graham Christie, international authority on steam power engineering, was born in Manchester, Ont., Can., and obtained his engineering education at the University of Toronto.

His first employment was with the Westinghouse Machine Company, East Pittsburgh, Pa., where he took part in the development and construction of steam turbines and gas engines. Later as an engineer for the Allis-Chalmers Company, Milwaukee, Wis., he was in charge of erection, testing, and operation of the first steam turbine built by that company.

In 1909 he became assistant professor of steam and gas engineering at the University of Wisconsin. In 1914 he joined the faculty of The John Hopkins University, where since 1916 he has been in charge of the evening engineering and technological school.

His international reputation is based on consulting practice in many parts of the world where he has influenced design and construction of power projects. He has contributed liberally to technical journals here and abroad and to many engineering handbooks.

He served the Society as president in 1939. He is chairman of the Power Test Codes Committee, to whose work he has devoted himself for many years.

Honorary membership was conferred on Dr. Christie "in recognition of his pre-eminence in engineering education and steam power engineering and as a tribute to his excellent professional and cultural attainments and leadership."

THEODORE P. WRIGHT PRESENTS AIR COMMODORE WHITTLE WITH THE DANIEL GUGGENHEIM GOLD MEDAL; AIR MARSHAL SIR GUY GARROD IS AT THE RIGHT

LEWIS K. SILLCOX

Lewis Ketcham Sillcox, authority on railroad power and the control of railway trains, was born in Germantown, Pa., in 1886. His engineering education was obtained in New York, N. Y. and at the Ecole Polytechnique, Brussels, Belgium.

His first employment was with the New York Central Railroad where he advanced from apprentice to supervisor and shop engineer. In 1912 he became mechanical engineer for the Canadian Northern Railway System. Later he returned to the United States to serve the Milwaukee Road of the Illinois Central Railroad as general superintendent.

Since 1927 he has been vice-president of the New York Air Brake Company, where he has been active in developing improved methods of power application and of train control.

His citation for honorary membership reads:

"Few engineering executives can claim the qualities combined in LEWIS KETCHAM SILLCOX, eminent engineer, distinguished lecturer, leader and inspirer of men, a man active in the affairs of the Society, and a member of many technical societies. His permanent contributions to the science of engineering, and particularly that of transportation, have been of inestimable value. His high character and ennobling influence have resulted in the bringing out of the best in all those associated with him in business and in the transportation world. He has ever been a lover of wisdom and a searcher for truth. He looks not backward at his past accomplishments but always ahead toward the solution of new problems. He is an organizer and a builder of character particularly in young men. He is beloved by all those with whom he is associated."

DANIEL GUGGENHEIM MEDAL

This year it was the privilege of the A.S.M.E. to have the Daniel Guggenheim Medal for achievement in aeronautics presented at its Annual Meeting. President Yarnall called upon Theodore P. Wright, vice-president and director, Curtiss-Wright Corporation, last recipient of the award, to make the

presentation to Air Commodore Frank Whittle, Royal Air Force, Great Britain, "for pioneering the development of turbo-jet propulsion of aircraft."

Mr. Wright spoke briefly to explain that the Daniel Guggenheim Medal was a joint award of the Society of Automotive Engineers, The American Society of Mechanical Engineers, and the Institute of the Aeronautical Sciences. The medal was made possible by a gift of the Daniel Guggenheim Fund for the Promotion of Aeronautics. The fund is administered by the United Engineering Trustees, Inc. The award, which consists of a certificate and two medals, one of gold and the other of bronze, is considered the highest award in aeronautics.

Air Commodore Whittle gleefully unrolled the certificate and inspected the medals. He told the audience he must do this because he had heard so much about the award and he could not wait to see it.

He accepted the award, Air Commodore Whittle said, with "intense satisfaction" as an honor "to Great Britain, the Royal Air Force, and the team who did all the work." He spoke briefly about his visits to the United States and said he "enjoyed working with American engineers" whom he found "enthusiastic and of high quality."

A brief sketch of the achievements of Air Commodore Frank Whittle follows:

Frank Whittle, whose Whittle engine was the first successful application of the turbojet engine to aircraft, received his engineering education at Cranwell, the R.A.F. College, at Henlow, and Cambridge University. In 1928 at the age of 21 he was already thinking of jet-propelled aircraft when he was called upon to write a science thesis. For his subject he chose "The Future Development of Aircraft," and began his experiments.

In 1936, with the aid of two fellow-students, he formed Power Jets, Ltd., to enable him to develop his idea. The British Government became interested and in May, 1941, the Whittle engine was installed in a Gloster E-28, which proved itself in flight. When the British and the United States governments entered into an exchange of information, Air Commodore Whittle came to this country in 1942 in an advisory capacity.

In 1944, as a contribution to the war effort, he gave patent rights to his invention to the British Government.

When Great Britain announced a program for building a new superfleet of jet-propelled aircraft for the Royal Air Force and British civilian airlines, Air Commodore Whittle was chosen to direct the program as technical adviser on engine design and production at the Ministry of Supply.

PRESIDENT-ELECT O'BRIEN SPEAKS

After an introduction by President Yarnall, as the first A.S.M.E. president from the South, President-Elect Eugene W. O'Brien spoke briefly. He expressed greetings to his "fellow Rebels" and "fellow Yankees" and outlined the objectives of his administration. He would foster an active aggressive program, he said, first, to do something definite about the unification of the engineering profession and second, to provide some real service to the junior members of the Society, those engineers in the 22 to 35-year age group. He would consider his administration a failure if some progress in those directions was not made.

President Yarnall then introduced the vice-presidents of the A.S.M.E. by asking the following to stand: Alton C. Chick, A. R. Mumford, N. E. Funk, E. E. Williams, T. S. McEwan, S. R. Beitler, Linn Helander, and J. Calvin Brown. He also introduced L. K. Sillcox as new director at large, who was elected to fill the vacancy caused by the death of B. V. E. Nordberg. When all officers were standing they received the applause of the audience.

HIGH PRODUCTION AND EMPLOYMENT

Senator Ralph E. Flanders, who was scheduled as the main speaker at the dinner, was unable to attend because of illness. His speech, which arrived by mail, was read by Robert M. Gates, fellow and past-president A.S.M.E.

The maintenance of a high level of productive and profitable employment was the major material problem facing the United States, Senator Flanders said. The solution of the problem depends on close co-operation of high morals with skillful business, financial, and political techniques.

Senator Flanders' speech, "Some Things We Have Learned," is published on pages 7 to 9 of this issue.

President Yarnall closed the dinner meeting with a few remarks, after which a reception was tendered to the presidents and their wives, Mr. and Mrs. D. Robert Yarnall and Mr. and Mrs. Eugene W. O'Brien. Dancing followed in the Georgian Room.

VI—TECHNICAL COMMITTEES' PARTICIPATION

Following their usual custom the A.S.M.E. groups of technical committees co-operated with the professional divisions in the planning for and carrying through of sixteen technical sessions. In addition, these five technical-committee groups held 40 technical-committee meetings and conferences.

STANDING AND SPECIAL COMMITTEE MEETINGS

The five committees which determine the policies of the corresponding five groups of technical committees held their annual meetings during the week. The A.S.M.E. Standardization Committee, J. Hall Taylor, chairman, led with its meeting on Monday morning. The A.S.M.E. Research Committee, J. F. Downie Smith, chairman, came next with its meeting on Wednesday afternoon. The A.S.M.E. Power Test Codes Committee, A. G. Christie, chairman, and the A.S.M.E. Safety Committee, H. W. Gabor, chairman, held their meetings on Friday morning, the last day of the convention. The A.S.M.E. Boiler Code Committee, H. B. Oatley, chairman, held its meeting in the Engineering Societies Building on Saturday, following the close of the Annual Meeting. All of these meetings were very well attended.

RESEARCH GROUP

Beginning with a meeting of the new Special Research Committee on the Properties of Gases and Gas Mixtures scheduled for Monday morning, this group held thirteen special and joint research-committee meetings during the week. In most cases the business of these meetings had to do with the reports on the status of the studies in progress, with discussion of technical questions raised by the reports, and with plans for the work of the coming year. It should be recorded here that this group of technical committees sponsored jointly or solely 15 technical sessions for this Annual Meeting.

A list of the 13 research committees holding meetings, with the names of their chairmen, follows. A total of 187 persons attended these meetings.

Standing Committee on Research, J. F. Downie Smith, chairman.
Properties of Gases and Gas Mixtures, J. A. Goff, chairman.
Automatic Regulation Theory, C. E. Mason, chairman.
Metal Cutting Data and Bibliography, (two meetings) M. E. Martellotti, chairman.
Strength of Vessels Under External Pressure, F. V. Hartman, chairman.

Cutting Fluids, O. W. Boston, chairman.
Plastic Flow of Metals, A. Nadai, chairman.
Fluid Meters, S. R. Beitler, chairman.
Lubrication, B. L. Newkirk, chairman.
Condenser Tubes, A. E. White, chairman.
Boiler Feedwater Studies, Executive Committee, C. H. Fellows, chairman.
Effect of Temperature on the Properties of Metals, N. L. Mochel, chairman.

STANDARDS GROUP

The standards group of technical committees held a total of 14 meetings during the week. All of them were well attended. Two of them, the Sectional Committee B1 on the Standardization and Unification of Screw Threads, E. J. Bryant, chairman, and the Subcommittee on Design and Dimensioning of Drawings with Tolerances and Allowances, Z14, H. L. Keller, chairman, had a definite international significance.

The following is a list of the standards committees which held meetings within the week and had a total attendance of 236.

A.S.M.E. Standardization Committee, J. Hall Taylor, chairman.

Subcommittee No. 1 on Graphical Symbols for Use on Drawings in Mechanical Engineering, Z32, W. J. Kunz, chairman.

Technical Committee No. 2 on Tool Posts and Tool Shanks, B5, O. W. Boston, chairman.

Technical Committee No. 17 on Nomenclature for Small Tools and Machine Tool Elements, B5, O. W. Boston, chairman.

Graphical Symbols and Abbreviations for Use on Drawings, Z32, W. L. Heard, chairman.

Technical Committee No. 10 on Forming Tools and Holders, B5, W. C. Mueller, chairman,

Standardization and Unification of Screw Threads, B1, E. J. Bryant, chairman.

Technical Committee No. 7 on Twist Drills, B5, R. L. Wilhite, chairman.

Subcommittee on Scope and Intent of the Code for Pressure Piping, B31, Sabin Crocker, chairman.

Subcommittee No. 1 on Plain Washers, B27, Perry House, chairman.

Plain and Lock Washers, B27, W. L. Barth, chairman.

Subcommittee on Design and Dimensioning of Drawings with Tolerances and Allowances, Z14, H. L. Keller, chairman.

Technical Committee No. 6 on Designations and Working Ranges of Machine Tools, B5, John Haydock, chairman.

Small Tools and Machine Tool Elements, B5, W. C. Mueller, chairman.

POWER TEST CODES GROUP

Meetings of seven of the committees of the power test codes group were scheduled and held during the Annual Meeting week. The business transacted at these meetings was largely of a routine nature and had to do primarily with the completion of revisions of test codes now available in pamphlet form. The one exception to this statement was the meeting of P.T.C. Committee on Gas Turbines. This committee, headed by J. I. Yellott, has progressed a considerable way toward the completion of a new test code for gas turbines.

A list of the names of these seven committees with the names of their chairmen follows. The total attendance at this group of meetings was 80.

A.S.M.E. Power Test Codes Committee, A. G. Christie, chairman.

Centrifugal and Rotary Pumps, F. G. Switzer, chairman,

Refrigerating Systems, B. H. Jennings, chairman.

Steam Locomotives, L. H. Fry, chairman.

Hydraulic Prime Movers, S. Logan Kerr, chairman.

Gas Turbines, J. I. Yellott, chairman.

Centrifugal and Turbo-Compressors and Blowers, A. Peterson, chairman.

SAFETY GROUP

The activities of the safety group of committees for 1946 was limited to a meeting of the standing committee on Friday morning and the sponsoring of a technical session Friday afternoon. There was a full attendance at the committee meeting and seventy-five were present at the session.

H. J. Stack presided at the session and W. F. O'Connor acted as recorder. The four papers which were read and discussed are as follows:

"Methods of Accident Control for Engineers," by H. W. Heinrich.

"The Educator's Opportunities in the Field of Accident Prevention," by Walter A. Cutter.

"Engineering College Training for Management Accident Control," by A. W. Luce.

"The Student Engineer Prepared for Safety Engineering," by John Grimaldi.

BOILER CODE GROUP

This year it happened that the regular meeting of the A.S.M.E. Boiler Code Committee fell within the week of the Annual Meeting. Four meetings, including that of the main committee were held, and a total attendance of 74 was recorded.

A list of the names of these four committees with the names of their chairmen follows:

A.S.M.E. Boiler Code Committee, H. B. Oatley, chairman.

Subgroup on Nonferrous Pressure Vessels, Walter Samans, chairman.

Special Committee on Openings and Reinforcements, F. S. G. Williams, chairman.

Special Committee on Bolted Flanged Connections, F. S. G. Williams, chairman.

ACTIONS OF GENERAL INTEREST

At the meeting of the Sectional Committee on the Standardization and Unification of Screw Threads, B1, the four-man mission which had just returned from London made its report on agreements reached concerning the gaging of a unified form of screw threads. The members of the mission were F. S. Blackall, Jr., G. S. Case, W. H. Gourlie, and F. P. Tisch. The sectional committee then proceeded to draft the answers to the seven questions included in a British questionnaire just received on the general subject of screw-thread unification.

A high light of the meeting of the A.S.M.E. Boiler Code Committee was the announcement that the committee plans to hold one of its regular meetings in 1947 in California, probably during the third week of May. In connection with this meeting it plans to hold one or more public hearings on a new draft of the proposed revision of the A.S.M.E. Code on Unfired Pressure Vessels which will be completed early in January.

At its meeting on Thursday, December 5, the Special Research Committee on Fluid Meters elected Samuel R. Beitler, professor of hydraulic engineering at The Ohio State University, Columbus, Ohio, to the chairmanship of this important committee. Professor Beitler will fill the vacancy made by the resignation of Reginald J. S. Pigott who has led this committee's activity since its appointment some years ago.

The A.S.M.E. Safety Committee recommended that the Society accept the American Standards Association's invitation to serve as cosponsor with the National Conservation Bureau for a committee which will be organized to develop a new safety code for manlifts under the procedure of the A.S.A.

This committee received and approved the recommendation of the A.S.M.E. Materials Handling Division to the effect that the Society suggest to the American Standards Association the organization of a committee to formulate a safety code for industrial power trucks.

VII—INDUSTRIAL FILMS

Because of the favorable reception of industrial motion pictures on the program of the 1945 Annual Meeting a broadened program of industrial films was included in the program of the 1946 Annual Meeting.

On Tuesday evening, December 3, more than 150 members and many women guests enjoyed four carefully chosen films. For convenience of members the films were scheduled at half-hour intervals.

"On the Air," by Westinghouse Electric Corporation showed what goes on in a modern radio station.

What good transportation means to a modern city was depicted in a film "Life Stream of the City," by the General Electric Company.

An amusing informative film "Tornado in a Box," by the Allis-Chalmers Manufacturing Company, described the theory and design of the gas turbine.

"Cyclone Combustion," by the Wright Aeronautical Corporation, depicted the theory of flame propagation and the control of detonation within the cylinder of an internal-combustion engine.

The imaginative rendering of complex engineering processes, the use of color, and tricks of photography provided both entertainment and information.

Motion pictures were also shown on Thursday, December 5. Four other films were shown. Again the shows were well attended and attracted many women guests.

VIII—PLANT TRIPS

On Monday morning the Otis Elevator Company, Yonkers, N. Y., was host to members in attendance at the Annual Meeting who were given the opportunity to see in operation the varied manufacturing techniques and processes in connection with the production of elevators, both passenger and freight types, including driving mechanism, elevator cars, and controls. There were also visits to the several machine shops, brass and iron foundries, heat-treating department, engineering department, and chemical and physical laboratories.

A limited group of members made an inspection trip on Monday afternoon aboard the *S. S. America*, largest and finest liner ever built in this country. The liner was anchored at Pier 61, North River, foot of 21st St., New York.

On Tuesday a group visited the United Nations Headquarters, Lake Success, L. I., where they were given a block of seats to witness the proceedings of one of the United Nations meetings.

The Waterside Plant of the Consolidated Edison Company of New York, Inc., 41st St. and East River, New York, N. Y., was visited by members and guests on Wednesday afternoon by special invitation. An invitation was also extended by the company to make an inspection trip any day from Monday through Friday.

Also on Wednesday afternoon the Grace Line welcomed members aboard the *S. S. Santa Margarita*, at Pier 58, North River, foot of 16th St., New York, a modern C-2 type passenger-freight ocean-going liner plying between New York and the West Coast South American ports.

The Ford Motor Company, Edgewater, N. J., was host to members on a guided tour through the entire assembly operations. Edgewater is the second largest Ford Assembly plant in the country, with a capacity of turning out 350 cars per day. Visitors witnessed the raw material through to the finished car rolled off the line.

On Friday afternoon members visited the American Sugar Refining Company's plant at 21 S. Second St., Brooklyn, N. Y., where they saw the materials handling of solid and liquid raw sugar from pier to shipping, including process of centrifuging, defecation, filtration, crystallization, and drying.

Members of the Textile Division and their guests made an inspection trip to the Reiner Textile Machine Company, Weehawken, N. J., on Friday, where they saw high-speed tricot machines, combination knitting and weaving looms, high-speed sectional beam warpers, auto heelers for knitting French heels, and all types of creels in the process of manufacture. Before going through the plant the visitors were the guests of Dr. Robert Reiner at a luncheon held at the Swiss Town House in Weehawken.

Two special trips were arranged for the students, one of which took them through the printing plant of the New York *World-Telegram*, and the other through the Tech-Art Plastics Company, Long Island City, N. Y., where they saw the fabrication of parts from plastics by compression-injection and transfer molding.

IX—COLLEGE REUNIONS

The annual meeting is a time of reunions. This year the Harvard Engineering Society held its meeting in the Biddle Room of the Harvard Club, 27 West 44th St., New York, on Thursday evening for a buffet dinner, following which William C. Schoolfield, chief of aerodynamics of the Chance Vought Aircraft Division, United Aircraft Corporation, spoke on "Flying Faster Than Sound." Fifty-seven alumni were present. On the same evening Clarkson Tech Alumini Association held a dinner meeting in the rooms of the Building Trades Employers Association, 2 Park Ave., New York. Forty-four were present.

The Georgia Tech Club of New York held its reunion dinner on Thursday evening, at the Dartmouth Club, 37 East 39th St., New York. Dr. Blake R. Van Leer, president of Georgia School of Technology, was the principal guest of the evening. Sixty-one attended.

A luncheon was held at the Engineers' Club on Thursday, by the University of Michigan. Dean Ivan W. Crawford, College of Engineering, University of Michigan, was the speaker. Thirty-five were present.

New York University opened its offices and laboratories of the department of mechanical engineering on Thursday from 9:00 a.m. to 5:00 p.m. to welcome returning alumni.

The Purdue Club of New York held its annual "Dean Potter Night" at a dinner meeting on Thursday evening in the rooms of the Building Trades Employers Association, 2 Park Ave., New York, and the Rensselaer Polytechnic Institute Alumni held a luncheon meeting on Thursday at the Cafe Rouge, Hotel Pennsylvania. The same evening Stevens Institute of Technology's Reunion Stag Dinner was held at the Stevens Metropolitan Club, 106 West 56th St., New York. Eighty alumni were present.

Worcester Polytechnic Institute Alumni Association held their dinner meeting on Thursday at the Hotel Shelton, Lexington Ave. and 49th St., New York. The principal speaker was Rear Admiral (Retired) Wat T. Cluverius, president of Worcester Polytechnic Institute. Ninety were on hand.

On Friday a get-together of the Yale Engineering Association was held at the Yale Club, 50 Vanderbilt Ave., New York.

Football pictures were shown by Assistant Coach Reggie Root.

X—COMMITTEES IN CHARGE

Meetings of The American Society of Mechanical Engineers come under the general supervision of the Committee on Meetings and Program. The technical program is provided by the Society's professional divisions and technical committees. Other features are planned and supervised by committees organized within the Metropolitan Section. In grateful acknowledgment of the many committees whose efforts contributed so substantially to the success of the 1946 Annual Meeting their personnel is listed in what follows:

Meetings and Program Committee: R. A. North, chairman, D. S. Walker, P. W. Thompson, G. B. Warren, and L. C. Morrow, with C. H. Carman, Jr., and E. S. Rowell as junior advisers.

Committee on Dinner and Honors: L. B. Schueler, chairman, G. J. Nicastro, vice-chairman, C. F. Beckwith, Walter L. Betts, R. W. Flynn, William Johnston, and Mrs. Crosby Field.

Board of Honors and Awards: L. W. Wallace, chairman, R. C. Muir, Eugene W. O'Brien, Charles M. Allen, and Clarke Freeman.

Committee on Medals: L. W. Wallace, chairman, E. C. Hutchinson, W. H. Kenerson, Erik Oberg, F. H. Colvin, L. H. Fry, P. E. Holden, R. C. Muir, F. M. Feiker, E. L. Hopping, E. W. O'Brien, C. T. Ripley, C. M. Allen, N. E. Funk, Warner Seely, B. R. Van Leer, J. B. Ennis, Clarke Freeman, B. P. Graves, and H. R. Westcott.

Plant Inspection Committee: R. W. Flynn, chairman.

Junior Group Activities: B. H. Edelstein, chairman, B. E. Bauder, R. G. Biedermann, H. E. Cook, Jr., D. Friedman, Peter Katz, W. E. Momot, A. W. Rousku, and D. R. Tarallo.

Ushers: B. H. Edelstein and W. H. Larkin.

Student Aide Committee: C. P. Bacha, A. H. Church, W. B. Moen, K. J. Moser, G. E. Peterson, J. L. Polaner, E. A. Salma, V. E. Scottron, F. L. Singer, S. J. Tracy, and W. A. Vopat.

Women's Events Committee: Mrs. R. M. Gates, honorary chairman, Mrs. George W. Nigh, general chairman, Mrs. W. L. Iliff, general vice-chairman:

Registration: Mrs. H. E. Erb, chairman. Hostesses: Mrs. H. R. Kessler, chairman. Tea Dance: Mrs. C. H. Young, chairman; Mrs. F. M. Farmer, co-chairman. United Nations Trip; Mrs. F. M. Gibson, chairmen; Mrs. L. W. Bennett; Mrs. Erik Oberg. Annual Luncheon: Mrs. J. N. Landis and Mrs. G. W. Nigh, co-chairmen. "AsKme" Girls: Mrs. Crosby Field, chairman, Mrs. F. M. Gibson, Mrs. G. A. Harman, and Mrs. Roy V. Wright. Statue of Liberty Boat Trip: Mrs. B. Zenaty, chairman. Hotel New Yorker, Terrace Room Luncheon: Mrs. W. L. Iliff, chairman. Theater Party: Mrs. W. L. Iliff. Conducted Tour to Museum of Natural History: Mrs. H. R. Kessler, chairman.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Applied Atomic Power

APPLIED ATOMIC POWER. By Edward S. T. Smith, A. H. Fox, R. Tom Sawyer and H. R. Austin. Prentice-Hall, Inc., New York, N. Y., 1946. Cloth, 6 × 9 in., 240 pp., 115 illus., $4.

REVIEWED BY A. C. KLEIN[1]

ANY group of authors undertaking to write a textbook on atomic power starts with two extremely heavy handicaps: security regulations and compartmentalization.

Security regulations limit them almost completely to the Smyth Report and to previously published textbook data. Compartmentalization is a limitation because no author can learn enough about the project to write a comprehensive book, but must confine himself to the particular area with which he was connected. Even the Smyth Report is not complete because of compartmentalization.

"Applied Atomic Power" comprises five sections: Part 1, "Natural Radioactivity," by Prof. E. S. C. Smith, professor of geology, Union College, includes the historical statement of the discovery of the several radioactive elements and lists the principal radioactive minerals, the location of their occurrence and their principal characteristics. Part 2, "Physical Background of Atomic Energy Production," by Dr. A. H. Fox, associate professor of mathematics, Union College, is a clearly written, popular statement of nuclear reactions, fission, and chain reaction. Part 3, "Summary of the Development of Atomic Energy Leading to the Atomic Bomb," also by Dr. Fox, is an abstract of portions of the Smyth Report. If it is not a complete treatment of the subject, the shortcoming in this respect may be ascribed to the incompleteness of the Smyth Report itself. Part 4, "Possible Methods of Converting Atomic Energy into Mechanical Power," by R. Tom Sawyer, chairman of the Gas Turbine Co-Ordinating Committee of the A.S.M.E., is a description of some of the methods by which atomic energy may be converted into mechanical power. This section strongly stresses the gas turbine as a prime mover by which atomic energy will become commercially available, an emphasis probably due to Mr. Sawyer's keen interest in the gas turbine. Part 5, "Industrial Benefits from U-235 Research," by H. R. Austin, executive vice-president of the Kellox Corporation, describes industrial benefits that should accrue from the research which accompanied the development of the gaseous diffusion of the process. Here, too, Mr. Austin has been limited by compartmentalization to the process with whose development he was primarily concerned.

Those who contemplate an excursion into the vast unexplored field of applied atomic energy will gather from this publication some conception of the enormous program of research and engineering development which must be carried on before atomic energy becomes a factor in our everyday life.

[1] Engineering Manager, Stone & Webster Engineering Corp., Boston, Mass. Fellow, A.S.M.E.

Top-Management Planning

TOP-MANAGEMENT PLANNING. By Edward H. Hempel. Harper & Brothers, New York, N. Y., 1945. Cloth, 5¼ × 8½ in., 414 pp., illus., $4.50.

REVIEWED BY CLARENCE THULIN[2]

THIS book limits itself to the planning functions of top management as distinct from the operating functions. While this sphere of activity may frequently receive a minor proportion of top-management's time, its effect on the long-term success of any enterprise can hardly be overestimated.

It supplies a comprehensive coverage of many subjects involved in the broader phases of planning which are difficult to find in the literature. These are well discussed and a variety of techniques suggested, including a coverage of many practical objections which might occur to the questioning reader and which, in many books of this type, are left unanswered. Also included are points of importance which are frequently overlooked, so that it has value as a check list in any major planning.

The author is careful not to overrate so-called "scientific methods" but aims to supply practical suggestions for dealing with those problems which have no truly scientific solution but which top management must face.

He envisions a level of top-management performance including some functions occasionally delegated to others, but with which every good top manager should be familiar.

The work should appeal to every manager who is searching for knowledge which will improve his performance and is certainly stimulating to top-management thinking.

With complete headings, including numerous subtitles to facilitate reference, and with sufficient listing of source material to provide for further study, this book should be a welcome addition to the rather limited literature of genuine interest to top management.

[2] Bigelow, Kent, Willard & Company, New York, N. Y.

Books Received in Library

AERODYNAMICS. By A. W. Sherwood. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, 6 × 9¼ in., 220 pp., illus., diagrams, charts, tables, $2.75. The more practical aspects of both theory and experiment in the field of aerodynamics are covered. Unusual emphasis has been placed upon the physical side of the theory in order to provide a general background for more intensive mathematical work. This permits the introduction of advanced topics such as compressibility and flutter. Experimental methods are discussed at considerable length because of the importance of model tests, and a description of the more important wind-tunnel corrections is included. There is a brief final chapter on "unconventional aircraft," covering the helicopter, jet propulsion, etc.

AIRCRAFT CARBURETION. By R. H. Thorner. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London, England, 1946. Cloth, 5½ × 8½ in., 393 pp., illus., diagrams, charts, tables, $3.50. Intended for both the practical man in any phase of the aviation field as well as for the student, the book first presents the fundamental principles of carburetion and then uses modern aircraft carburetors as examples to prove the basic similarity. There is special emphasis on pressure,

Library Services

ENGINEERING Societies Library books may be borrowed by mail by A.S.M.E. members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any item in its collection. Address inquires to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

pressure measurement, and pressure instruments. The author discusses the principles of operation of the fuel pump and supercharger in relation to the carburetor and engine, and provides a thorough coverage of fuel economy. The book is concerned primarily with operating principles and no attempt has been made to cover maintenance details.

AIRCRAFT YEAR BOOK for 1946, twenty-eighth annual edition, by H. Mingos. Official publication of Aircraft Industries Association of America, Inc.; published by Lanciar Publishers, Inc., New York, N. Y., 1946. Cloth, 6 × 9 in., 702 pp., illus., diagrams, tables, $6. This annual contains a vast amount of up-to-date information on all phases of aviation. In addition to the usual statistics and directory of manufacturers and associations, this edition records our part in the air war and includes chapters on air transportation, airports, airways, private flying, aviation education, aircraft power plants, new aviation accessories, and postwar plans for aviation.

AIRPORTS: Design, Construction and Management. By H. K. Glidden, H. F. Law, and J. E. Cowles. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, 6 × 9¼ in., 583 pp., illus., diagrams, charts, tables, $7. The first part of this comprehensive work outlines the requirements and factors entering into the problem of site selection and runway layout. This is followed by a condensed version of the field and laboratory tests and procedure for grading, drainage, and pavement design. Turfing, lighting, radio aids, traffic control, communications, and the basic principles of management are covered. Special features of the book are a discussion of the role of the United States Government in the design and construction of civil airports; a chapter on obstructions, their lighting and removal; and a 300-page appendix containing full and exact specifications and test procedures for materials and construction methods.

A.S.T.M. STANDARDS ON RUBBER PRODUCTS (with related information), prepared by A.S.T.M. Committee D-11 on Rubber Products; Methods of Testing, Specifications, March, 1946. American Society for Testing Materials, Philadelphia, Pa. Paper, 6 × 9 in., 540 pp., illus., diagrams, charts, tables, $3.25. More than 75 specifications and tests covering natural and synthetic rubbers are collected in this publication. The largest section covers general methods of analysis, identification, and testing. The following sections deal with electrical tests; insulated wire and cable; hose, belting, gloves, tape; nonrigid plastics; and tests and specifications for miscellaneous products not previously covered. There is a section on nomenclature and definitions and a number of proposed specifications are included to solicit comment.

APPLIED ELASTICITY. By J. Prescott. Dover Publications, New York, N. Y., 1946. Cloth, 5½ × 8¾ in., 666 pp., diagrams, charts, tables, $3.95. Written from the viewpoint of the engineer rather than the mathematician, the mathematical theory is carried out only so far as is necessary for its application to practical problems. General stress-strain relations are first dealt with, followed by a number of chapters on thin rods, thin plates, and cylinders under various conditions of pressure and strain. Separate chapters are devoted to the vibrations of rotating disks and to elastic bodies in contact.

CAREER OPPORTUNITIES, edited by M. Morris. Progress Press, Washington, D. C., 1946. Cardboard, 6 × 9¼ in., 354 pp., illus., $3.25. Over a hundred occupations offering substantial possibilities in the postwar world are briefly considered. The information covers the nature of the work involved, the necessary qualifications, how and where to get the proper training and education, and the normal expectation in wages, salary, or fees. The fields of industry, business, agriculture, engineering, science, medicine, social work, the arts, education, and religion are covered, from the clerical worker and mechanic to the professional man.

CONTRIBUTION TO THE PHYSICS OF CELLULOSE FIBRES. By P. H. Hermans. Elsevier Publishing Co., London, New York, N. Y., Amsterdam, and Brussels, 1946. Paper 6 × 8½ in., 221 pp., illus., diagrams, charts, tables, $4. The fiber materials used in the research here described were regenerated cellulose, rayon, and natural fibers such as ramie and cotton. The theoretical part which occupies most of the book deals with such fiber characteristics and properties as density, liquid sorption, refractive power, and x-ray studies on orientation. In the last twenty pages experimental procedures for determining certain physical constants of fibers are treated in some detail. The book is one of a series describing research work done in Holland during the War.

EFFICIENT USE OF FUEL, with foreword for the American Edition by J. C. Olsen. Chemical Publishing Co., Brooklyn, N. Y., 1945. Cloth, 5½ × 8¾ in., 807 pp., illus., diagrams, charts, tables, $8.50. This very comprehensive book, the work of a group of British technologists, covers all aspects of the subject: the composition and properties of all types of fuel; the theories and principles of combustion; the equipment used in burning coal and other solid fuels, fuel oil, and industrial gases; boiler efficiency and testing; water purification and auxiliary-boiler equipment; the utilization of steam for industrial processes, central heating, and evaporation; automatic control; and the sampling and analysis of coal and gases. The book is intended both for the student and for the technical man in industry.

ENGINEER AT LAW. Two volumes. By C. B. McCullough and J. R. McCullough, with forewords by J. T. Brand and J. M. Devers. Iowa State College Press, issued in 1946 by The Collegiate Press, Ames, Iowa, under co-operative agreement with the Oregon State Highway Department. Cloth, 6 × 9¼ in., vol. 1, 447 pp.; vol. 2, 442 pp.; $3 each volume, $6 both volumes. The object of this work is to provide the engineer with a source of information which will help him to avoid legal pitfalls and to deal more efficiently with problems which arise if legal difficulties do occur. Volume 1 covers court procedures, systems of jurisprudence, and equity considerations. It discusses the important topics of contracts and contractual relationships, engineering specifications, real property laws, and torts incident to engineering operations. Volume 2 considers the engineer in trial work as technical witness or consultant and deals with employment relations, patents, negotiable instruments, and numerous special laws of interest to the engineer.

FINISHING METAL PRODUCTS. By H. R. Simonds and A. Bregman. Second edition. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, 5 × 8½ in., 352 pp., illus., diagrams, charts, tables, $4. This new edition describes developments that took place in recent years, including war years. As in the earlier edition, it emphasizes finishing for appearance and sales value and includes new information on coloring metal, costs, and organic coatings.

GRAISSAGE DES MACHINES. By P. Martinet. Dunod, Paris, 1946. Paper, 6½ × 10 in., 223 pp., diagrams, charts, tables, 430 fr. The object of this book in general is to determine the most efficient materials and methods for a variety of lubrication problems. The characteristics, properties, and treatment of lubricants are covered, and the efficacy of various methods of application is discussed. Special applications dealt with are internal-combustion-engine cylinders, steam-locomotive cylinders, air and gas compressors, metal cutting and drawing, and laminated plastic materials.

GYROSCOPE AND ITS APPLICATIONS, edited by M. Davidson. Section 1: General Theory, by M. Davidson. Section 2: Marine Applications, by G. C. Saul. Section 3: Aeronautical Applications, by J. A. Wells and A. P. Glenny. Hutchinson's Scientific and Technical Publications, London, England, and New York, N. Y., 1946. Cloth, 5½ × 8¾ in., 256 pp., illus., diagrams, charts, 21 s. The first seventy pages are devoted to a discussion by the editor of general theory, including types of gyroscopes and gyroscope problems concerned with the dynamics of the instrument. In sections 2 and 3 specialists in the fields describe in detail the particular applications of the gyroscope for marine and aeronautical purposes, as exemplified by a large number of specific instruments. Each of the three sections is intended to be self-explanatory for the convenience of the reader.

HANDBOOK OF CUPOLA OPERATION, published by American Foundrymen's Association, Chicago, Ill., 1946. Cloth, 6 × 9¼ in., 470 pp., illus., diagrams, charts, tables, $5.50. Beginning with a historical summary of the metallurgy of iron, this handbook proceeds to take up in detail the full range of cupola operations. Topics covered include cupola construction, lining, charging equipment, blowing equipment, blast control, fuel, slags and fluxes, thermal equilibrium, and actual operational procedures. There are a twenty-seven page table of specific applications of alloy cast iron and a bibliography of some 500 references.

HEAT-TREATMENT OF CARBON STEELS. By F. Johnson. Chemical Publishing Co., Brooklyn, N. Y., 1946. Cloth, 5½ × 8¾ in., 204 pp., illus., diagrams, charts, tables, $4. This volume is the first of a series of four intended to provide a source of information on the treatment which metals and alloys receive before being delivered to the engineer for his use. The present volume covers the influence of composition and treatment on the structure and properties of carbon steel, the various practical heat-treating operations, the important topic of hardenability, and the de-

scription and testing of mechanical properties. Succeeding volumes will deal with alloy steels, cast iron, and nonferrous alloys; surface-hardening processes; furnaces and pyrometry.

HUMAN FACTORS IN MANAGEMENT, edited by S. D. Hoslett. Park College Press, Parkville, Mo., 1946. Cloth, 6 × 9 in., 322 pp., $4. This collection of reprinted articles by authorities brings together some eighteen discussions of various phases of the problem. Broadly classified, they deal with the nature and conditions of leadership, leader or foreman training, worker reactions, and adjustments through the counseling method. A group of four special articles presents the viewpoints of a psychologist, and anthropologist, and a sociologist with regard to the whole field, and a systematic treatment of the general question of morale.

INDUSTRIAL CARBON, its Elemental, Adsorptive, and Manufactured Forms. By C. L. Mantell. Second edition. D. Van Nostrand Co., Inc., New York, N. Y., 1946. Cloth, 6 × 9¼ in., 472 pp., illus., diagrams, charts, tables, $7.50. This revision of a standard work has four sections: The elemental forms of carbon, the diamond, natural graphite, carbon black, acetylene black, lamp black, and pigments, with their applications, form the first section; the second covers the adsorptive forms; the third section deals with the manufactured forms, artificial graphite, electrodes, brushes, arc-light carbons, specialties and resistors, materials of construction, porous forms, electronic-tube anodes, and refractories; the fourth section includes analytical and testing methods, and physical and chemical properties. Many bibliographical references are included.

INDEX OF MATHEMATICAL TABLES. By A. Fletcher, J. C. P. Miller, and L. Rosenhead. McGraw-Hill Book Co., Inc., New York, N. Y.; Scientific Computing Service Limited, London, England, 1946. Cloth, 6 × 9½ in., 450 pp., diagrams, tables, $16. This valuable compilation provides a complete index to all published and some unpublished mathematical tables both in books and in magazines. Part 1 consists of 24 sections, each devoted to tables of a particular group of functions: logarithms, natural functions, exponential functions, Bessel functions, etc. The tables are generally listed in decreasing order of the number of decimals. Part 2 contains a listing of the references to tables arranged alphabetically by authors and chronologically under each author. The user refers from Part 1 to Part 2 for the complete reference.

INDUSTRIAL ELECTRIC HEATING AND ELECTRICAL FURNACES. By E. S. Lincoln. Essential Books, Duell, Sloan, and Pearce, New York, N. Y., 1945. Cloth, 5¼ × 8¼ in., 192 pp., illus., diagrams, charts, tables, $3. The three principles of electric heating—resistance, infrared, and induction—are discussed, with detailed descriptions of the equipment by which they are put to practical use. Electric steam boilers, electric ovens and driers, and electric furnaces are dealt with particularly, including discussion of efficiencies and the calculation of heating requirements. Space is devoted to the selection and installation of heating units.

MAGNESIUM, by L. M. Pidgeon, J. C. Mathes, N. E. Woldman, J. V. Winkler, and W. S. Loose. American Society for Metals, Cleveland, Ohio, 1946. Cloth, 6 × 9¼ in., 265 pp., illus., diagrams, charts, tables, $3.50. The five lectures collected in this volume were presented in 1946 and deal respectively with the extractive metallurgy of magnesium, magnesium structural design, magnesium castings, a survey of wrought magnesium alloy fabrication, and the corrosion and protection of magnesium.

MANUAL OF OPERATION FOR THE AUTOMATIC SEQUENCE CONTROLLED CALCULATOR. (Annals of the Computation Laboratory of Harvard University, Vol. 1.) By the Staff of the Computation Laboratory with a foreword by J. B. Conant. Harvard University Press, Cambridge, Mass.; Geoffrey Cumberlege, Oxford University Press, London, England, 1946. Cloth, 8 × 11 in., 561 pp., illus., diagrams, charts, tables, $10. A historical introduction surveys the development of mechanical aids to calculation from the days of the abacus to the present. It is followed by a description of the calculator; by chapters on the general principles of its operation, its electrical circuits, coding, plugging instructions, and the solution of examples; and by detailed appendixes on the methods of operation of the calculator's various parts. Not designed for a specific purpose, this generalized machine performs a wide variety of computations useful in all scientific fields. A bibliography and an index are included.

MATHEMATICAL THEORY OF ELASTICITY. By I. S. Sokolnikoff, with the collaboration of R. D. Specht. McGraw-Hill Book Co., Inc. New York, N. Y., and London, England, 1946. Cloth, 6 × 9¼ in., 373 pp., diagrams, charts, tables, $4.50. The first three chapters contain a comprehensive treatment of the underlying theory of the mechanics of deformable media. Chapter 4 gives an up-to-date treatment of extension, torsion and flexure of homogeneous beams. Chapter 5 contains a development of variational methods necessary for the treatment of problems of elasticity. Several procedures for deducing approximate solutions of the boundary value problems of mathematical physics are outlined and illustrated.

METALLURGY OF QUALITY STEELS. By C. M. Parker. Reinhold Publishing Corporation, New York, N. Y., 1946. Cloth, 6 × 9¼ in., 248 pp., illus., diagrams, charts, tables, $6. Following a brief chapter on the general nature of steel, this introductory text discusses steel quality as related to methods of manufacture, chemical composition and control, ingot, and rolling practice. Heat-treating, testing, and inspection procedures are described, and the effects of alloying and incidental elements are considered. Hardenability and other special characteristics are dealt with, and a final chapter tabulates the general characteristics of standard steel grades.

METALLIC CORROSION, PASSIVITY, AND PROTECTION. By U. R. Evans, with an appendix by A. B. Winterbottom. Longmans, Green & Co., New York, N. Y., 1946. Revised edition. Cloth, 5¾ × 9½ in., 863 pp., diagrams, charts, tables, $14. The material in the new edition has been rearranged with considerable addition of recent developments. The first two chapters present simple examples of corrosion and passivity and a study of thin films. Corrosion under varying conditions, such as with and without oxygen, is described in succeeding chapters, followed by a discussion of the influence of stress, structure, and crevices. Four chapters are devoted to protection by various methods and the book ends with a section on testing. Each chapter is divided into three parts: the scientific basis; the technical aspects including practical problems; and the mathematical or quantitative, treatment.

MODERN DIESEL. Edited by G. G. Smith and revised by D. H. Smith. Tenth edition. Iliffe & Sons, Ltd., London, England, 1946. Cardboard, 4¼ × 7 in., 254 pp., illus., diagrams, charts, tables, 6 s. This small book published in Great Britain describes and gives illustrations of Diesel engines for road, rail, aircraft, and marine use. Largely descriptive of engines as a whole, it includes some information on accessories, applications, and lubrication, as well as a chapter on fuel-injection systems.

MODERN ORGANIC FINISHES, Their Application to Industrial Products. By R. H. Wampler. Chemical Publishing Co., Brooklyn, N. Y., 1946. Cloth, 5½ × 8½ in., 452 pp., illus., diagrams, $8.50. This book is primarily a book of methods. Descriptions of modern finishing materials and equipment for their application, drying, and conveying are presented, with emphasis on the proper selection and proper use of materials and equipment to get the best possible finish at minimum cost. Enamels, lacquers, varnishes, stains, and "synthetics" are mainly considered, with little consideration given to oil-base paints.

MOTEURS D'AVIONS, 2 volumes, text and planches. By R. Marchal, preface by P. Dumanois. Dunod, Paris, France, 1946. Paper, 7½ × 11 in., text, 643 pp., illus., diagrams, charts, tables, 3200 fr., 2 volumes. This comprehensive work on airplane engines first defines and identifies important parts and engine characteristics and gives a brief historical sketch. A considerable part of the book is devoted to the thermodynamics of fluids and of engines and compressors. Another group of chapters covers the strength of materials and the kinematics of engine parts. Carburetion, ignition, and lubrication are dealt with separately. Manufacturing practice and testing procedures are considered, and a chapter is devoted to unusual types of engines. Over a hundred plates and diagrams are contained in a supplementary volume.

ORGANIZED LABOR AND PRODUCTION, Next Steps in Industrial Democracy. By M. L. Cooke and P. Murray. Revised edition. Harper & Brothers, New York, N. Y., and London, England, 1946. Cloth, 6 × 8¾ in., 277 pp., diagrams, charts, $2.50. A prominent expert in scientific management and the head of a leading union join in setting forth what they both believe is the basis for greater collaboration among employers and organized workers to assure greater production under fair terms of employment. The book covers the responsibilities and activities of both labor and management and discusses some of the questionable practices of both.

PLANNING THE SMALL FACTORY. By A. H. Huckle. Mitre Press, London, England, 1946. Cloth, 5½ × 8 ¾ in., 133 pp., diagrams, charts, tables, 15s. This practical work presents a detailed description of the various elements which must be considered in a small concern of an engineering nature. Tables, charts, diagrams, and working drawings are freely used to consolidate or illustrate the important subject matter. Management and costs are considered as well as design and production methods. A factory producing small machine and equipment parts with a personnel of 500 is the example under consideration in the book.

RECENT AERONAUTICAL LITERATURE, a Selective Subject Index for 1945, compiled and edited by W. K. Dennis. Beech Aircraft Corporation, Wichita, Kansas, 1946. Paper, 8½ × 11 in., 387 pp., $5. Over 12,000 title entries from some sixty aeronautical periodicals (American, Canadian, and English) are included in this volume. They are arranged

alphabetically by title under a large number of selected subject headings. Many of the periodicals indexed (including a large number of company publications) are not covered by the commercial indexing services. A supplementary monthly publication is also available.

PRACTICAL DESIGNS FOR DRILLING, MILLING, AND TAPPING TOOLS. By C. W. Hinman. Second edition. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, $5^3/_4 \times 9$ in., 416 pp., illus., diagrams, tables $5. This practical manual demonstrates the best methods for designing, drafting, and using drilling jigs, gages, hand tools, and tapping and milling fixtures. It illustrates the fundamental principles by which all tools must be designed for successful operation. With a wealth of illustrative material, detailed operational functions of tools, mathematical formulas, tool engineering tables, etc., it supplies the essentials for beginners and suggests new ideas for the experienced man. A list of educational films in the field is included.

PRINCIPLES OF TOOL ENGINEERING. By R. R. Bloom. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, $5^3/_4 \times 9$ in., 234 pp., illus., diagrams, tables, $2.40. The important principles of tool engineering are adapted to the needs of beginning students. Among the fundamental topics covered are systems of production, interchangeability, and dimensioning as they pertain to tool design, the tool engineer's training and duties, and the basic machine tools. Recent advances dealing with methods of construction and welding symbols are included. A list of motion pictures is provided, correlated with the material in the text.

PSYCHOLOGY IN INDUSTRY. By N. R. F. Maier. Houghton Mifflin Co., Boston, Mass., New York, N. Y., Chicago, Ill., 1946. Cloth, $5^1/_4 \times 8^1/_4$ in., 463 pp., diagrams, charts, tables, $3. The author discusses in a nontechnical but systematic manner the various aspects of the industrial situation to which the principles of psychology are applicable. Beginning with the fundamental problem of why people act as they do, he covers morale and motivations, the allowance for variations in individuals, the use of psychological tests and the analysis of skills, fatigue conditions, and the prevention of accidents, and psychological factors in labor turnover. The book is designed for a wide audience from the student to top management.

REFRIGERATING DATA BOOK, Refrigeration Applications Volume, second edition. American Society of Refrigerating Engineers, New York, N. Y., 1946. Cloth, $6^1/_2 \times 9^1/_2$ in., 683 pp., Refrigeration Classified, 190 pp., illus., diagrams, charts, tables, $5. Each of the seventy-six chapters of this revised manual is devoted to a specific application or closely allied subject, beginning with the fundamental principles involved and continuing with a description of the processes employed. Covering practically the entire field, these chapters are grouped under the major section headings of frozen foods, cold storage, refrigeration in food manufacture, and distribution, special low-temperature applications, industrial uses, and air conditioning.

RESSORTS, étude complète et méthode rapide de calcul. By C. Reynal. Fourth edition. Dunod, éditeur, Paris, France, 1946. Paper, $5 \times 7^3/_4$ in., 253 pp., illus., diagrams, charts, tables, 265 fr. The author presents a detailed analysis of the design and action of the various kinds of springs—laminated, helical, spiral, multiple—and of spring washers. The last two chapters contain certain observations on springs in general and describe two special slide rules for making rapid calculations in spring design.

ROCKETS. By R. H. Goddard. American Rocket Society, New York, N. Y., 1946. Cloth, $6 \times 9^1/_4$ in., 69 pp. + 10 pp., illus., diagrams, charts, tables, $3.50. In 1919 and 1936 the Smithsonian Institution published two papers by Dr. R. H. Goddard, a pioneer in rocket and jet propulsion. These two papers have been reproduced in this small volume by facsimile printing. These two papers are "A Method of Reaching Extreme Altitudes," setting forth the fundamental theory, and "Liquid-Propellant Rocket Development," describing Goddard's first liquid-fuel rocket experiments. All of the original illustrations are included and a brief biographical note.

SALINITY, a Bibliography of Books, Periodicals, and Society Publications, appearing from 1845 through June 28, 1945, compiled by Claude C. Lee, Vicksburg, Miss., 1946. Paper, $8 \times 10^1/_2$ in., 60 pp. typewritten, $3. The main listing of the items in this bibliography is alphabetical by author. Brief annotations accompany nearly all of the more than 300 individual references. Detailed chronological and subject indexes are provided, and there is a note to the effect that the author is prepared to assist in locating any hard-to-find references.

SCIENTIFIC PROGRESS IN THE FIELD OF RUBBER AND SYNTHETIC ELASTOMERS (Advances in Colloid Science, vol. 2). Initiated by the late E. O. Kraemer, edited by H. Mark and G. S. Whitby. Interscience Publishers, Inc., New York, N. Y., 1946. Cloth, $6 \times 9^1/_4$ in., 453 pp., illus, diagrams, charts, tables, $7. Thirteen authorities have contributed the chapters contained in this volume which includes rubberlike synthetics both with and without the chemical composition of natural rubber. Topics discussed include: the properties, under various conditions, of rubbers, other high polymers, and compounding ingredients; crystallization phenomena, and x-ray diffraction methods of analysis; the kinetic theory of rubber elasticity; viscosity measurements; and vulcanization by heat or light.

S.A.E. HANDBOOK 1946 Edition. Society of Automotive Engineers, New York, N. Y., 1946. Cloth, $5^1/_2 \times 8^1/_4$ in., 842 pp., illus., diagrams, charts, tables, $5. This official publication contains the current S.A.E. Standards and Recommended Practices, except those specifically for aeronautical use, which are published separately on loose sheets, but are referred to in the Handbook by descriptions and listings. New and revised specifications are given a separate listing. A wide variety of materials, parts, fittings, tools, and tests are covered, and several codes and classifications are included.

SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS, Proceedings, vol. 3, no. 2, edited by C. Lipson and W. M. Murray. Published and distributed by Addison-Wesley Press, Inc., Cambridge, Mass., 1946. Cloth, $8^1/_2 \times 11^1/_4$ in., 166 pp., illus., diagrams, charts, tables, $5. Eleven papers on various aspects of the subject are contained in this volume, together with seven papers covering the proceedings of a panel discussion of fatigue failure of manufactured parts. The topics of the first eleven papers include the construction and use of strain gages, methods of stress analysis, and a study of the mechanical behavior of the skull and its contents under injuring blows. A list of members and the contents pages of the preceding volumes are included.

SOHO FOUNDRY. By W. K. V. Gale. W. & T. Avery, Ltd., Soho Foundry, Birmingham, England, 1946. Paper, $5^1/_2 \times 8^1/_2$ in., 49 pp., illus., maps, diagrams, 5s. This is a brief historical survey of an English manufacturing concern with which are connected three of the great industrial pioneers: Matthew Boulton, James Watt, and William Murdock. Biographical sketches of the three men are interwoven with the account of the development of the works.

STANDARD METAL DIRECTORY, tenth edition, 1946. Standard Metal Directory, New York, N. Y., Cloth, $5 \times 8^1/_4$ in., 852 pp., $10. This is a revised directory of iron and steel plants, ferrous and nonferrous metal foundries, metal rolling mills, smelters and refiners of nonferrous metals. In addition to these main sections, it includes lists of fabricators of bars, sheets, tanks, plates and structural shapes, as well as storage-battery manufacturers, sheet-metal stamping works, solder manufacturers, galvanizers, and scrap-metal dealers. Unfortunately, the table of contents is buried in the midst of the advertising and so hinders the use of the volume.

STEAM POWER PLANT AUXILIARIES AND ACCESSORIES. By T. Croft, editor, revised by D. J. Duffin, second edition. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1946. Cloth, $5^1/_2 \times 8^1/_4$ in., 583 pp., illus., diagrams, charts, tables, $5. A practical manual for the operating engineer, this book has been revised to conform with the changes that have taken place in the 24 years since it was originally published. Topics on which considerable new material has been added include reciprocating and centrifugal pumps, methods of boiler feeding, feedwater heaters, economizers and air preheaters, condensers, steam piping of power plants, and steam traps. As before, there are review questions and problems, and a technical data section has been added.

STEEL CASTINGS. By E. N. Simons. Paul Elek Publishers, Ltd., London, E.C.1, England, 1946. Cloth, $5 \times 7^1/_2$ in., 208 pp., illus., diagrams, charts, tables, 13 s. Raw materials, melting processes, patterns, foundry sands, molds, and cores are dealt with in the first few chapters. Postcasting processes, heat-treatment, and machining practice are subsequently covered. The steels used for castings are discussed in detail, including the types and uses of castings from these steels. Separate chapters are devoted to inspection and testing, centrifugal casting, and buying procedures on the part of the customer. A number of special castings are also described at the end.

WORKSHOP TECHNOLOGY, two parts. Part 1, 303 pp., $1.50; Part 2, 328 pp., $2.50. By W. A. J. Chapman. Edward Arnold & Co., London, England; Longmans, Green & Co., New York, N. Y., 1945. Cloth, $5^1/_2 \times 8^3/_4$ in., illus., diagrams, charts, tables. The full range of workshop operations is covered. The majority of the text deals with machine-tool work on the standard machines: lathes, shapers, milling machines, etc., covering the tools, speeds and feeds, indexing, and numerous detailed descriptions of actual jobs. The materials, ferrous and nonferrous, are described with their properties and heat-treatment. The hot-working of metals is considered, bench jobs are described, power devices and safety are discussed, and the elements of measurement and gaging are given full coverage.

A.S.M.E. NEWS

And Notes on Other Engineering Societies

President Yarnall Addresses A.S.M.E. Students on Unionism and Collective Bargaining at 1946 Annual Meeting

AT the Members and Students Luncheon, held on December 4, during the 1946 A.S.M.E. Annual Meeting, D. Robert Yarnall, president, spoke as follows:

The desire for collective action seems strong among many young engineers in our country. Within a year or two many of the students here today may share in this desire. What form action on this desire should take is a most important question facing our engineering profession today, and as good citizens we must not sidestep our responsibility in this area. Young engineers employed in large companies today are being pressed to join a representative bargaining group, because the unions are doubling their efforts to organize engineers. We understand further that the unions now are willing to accept responsibility for improving the economic status of the engineering personnel.

Let us bear in mind, however, that engineers, members of our Society, in the middle-age and older groups, are very largely executives and managers and chief engineers and they are responsible for the employment (among others) of younger engineers. They look upon the young men as the potential groups from which the next generation of managers and executives may come. The younger men are encouraged to join engineering societies and to write and discuss technical papers. They are invited by executives into their homes and to the various educational and social occasions for the purpose of broadening acquaintanceships.

Engineering Societies and Unions

If a young man joins a white-collar union representing engineers and draftsmen, how will the transition from his classification as a union member and his classification as an executive or manager be made?

On the other hand, someone questions: "Will not his experience with the union make him more understanding and so more valuable as an executive or as a manager when heavier responsibilities come his way, since apparently collective bargaining is here to stay?"

Engineering societies were created for the broad purpose of tabulating, recording, and disseminating engineering knowledge *for the good of mankind*. They have their social functions, affording opportunities for broadening contacts through professional meetings. They are also creators of codes and standards and ethical practices. Our societies are technical educational institutions of great importance. They are a great deal more than organizations created for the purpose of helping members make more money.

I was impressed a few weeks ago with what George William Taylor, author of the "Little Steel Formula" said at the Princeton Bicentennial about engineering societies having negative attitudes toward labor unionism and collective bargaining. One wonders how true this statement is.

It is true that the "best men have high scarcity value" hence they can best bargain individually. Men of average or less than average ability certainly have less power in individual bargaining, but does it necessarily follow that their best course for advancement would come through unionism and collective bargaining? Should not good management provide an adequate personnel policy which will not lose touch with either the best man, the average man, or the subaverage man and his needs and right for advancement? Can we better develop a broad professional spirit in industrial engineering than by driving home over and over again our conviction that management must assume more responsibility for encouragement, recognition, and advancement (when earned) of all technical men. "The potential professional serving his internship in a subprofessional group" as a union member in a larger company may gain very useful experience, but let him beware of the limitations of a system which is designed for the average engineer.

One is in agreement with George W. Taylor, when he says, "the times call for a personnel program by management and by engineering societies geared to the problems of insecurity faced by engineering employees."

It would seem that engineers should weigh carefully all of these values when they are confronted with decisions concerning collective action.

In the way of emphasis, may I add—the engineer needs to be a part of his *professional group* for his personal advancement. Furthermore, he needs it most at the beginning of his career, and let him remember that 53 per cent of A.S.M.E. members are classed as management. The remaining 47 per cent includes the large group of younger engineers in the early stage of their experience.

Possible Courses of Action

With this background let us examine what the possible courses of action may be, based on results obtained thus far.

1 The American Society of Mechanical Engineers has felt the impact of unionism and collective bargaining, especially upon younger engineers; but upon legal advice our Society is apparently inhibited from taking formal action. Hence, rightly or wrongly, we have taken these matters up through the Engineers Joint Council, on which Council each of our five societies has three representatives. The E. J. C. has established a Committee on the Economic Status of the Engineer, and three developments are emerging:

(*a*) Survey of Report of Earnings of 85,000 Engineers, Col. Wm. H. Carey, secretary, A.S.C.E., chairman, with relation to education, years of practice, and field of specialization; report to be completed about June 30, 1947.

(*b*) Survey of 200 industrial companies to determine company policies pertaining to selection, training, placement, advancement, guidance, and professional activities of graduate engineer employees, E. G. Bailey, chairman.

(*c*) Survey of the problem of collective bargaining as it affects or may affect engineers in professional work and in training for professional work. First manual, now ready for the printer, will provide guidance for engineer employees; I. Melville Stein, chairman.

2 Another course of action is suggested by the recent formation of the National Professional Employees Association. Twenty representatives of the San Francisco Area Group of Professional Employees have met for the formation of the National Professional Employees Association, comprising engineers, architects, industrial scientists, and similar professional employees. Their purposes are to promote welfare and professional status of members and the right of professional employees to bargain collectively *through agencies of their own choosing*. They plan to assist groups to set up independent bargaining units independent of the national unions.

3 A third plan of procedure is being urged. It suggests that the time has arrived when the Founder Societies must take positive and im-

mediate action to combat the expansion of labor unions into the engineering field. This point of view would encourage all members to obtain their professional licenses through their state section of the National Society for Professional Engineers. It is claimed that such positive action by all of the Founder Society members would enable the professional engineer to present a united front against the threat of unionization and in defense of the engineer's hard-earned status as a professional man.

4 The A.S.M.E. Regional Delegates Conference recommends that we urge revision of the Wagner Act to give autonomy to professional engineers.

5 Our Society recognizes the increasing concern of our juniors about the matter of unionization and the unfavorable comparison our juniors make with the programs of some of the other engineering societies in this connection.

On December 2 the A.S.M.E. Council voted to set up a committee of five members, three of whom are to be men with less than 10 years of engineering experience, for the following purposes:

(*a*) To develop opportunities of junior engineers in engineering societies and in industry.

(*b*) To interpret survey reports flowing from the E. J. C. Joint Committee on Economic Status of the Engineer.

(*c*) To maintain contact with the current activities of the Joint Committee on Economic Status so that, from the personnel of this committee, full representation can be provided at meetings and other activities of the Joint Committee.

Finally, our Society is anxious to be of service to its young membership in this controversial area, if it can find solid ground on which such service can be rendered.

A sense of direction is desirable and is expected by our younger members. They want some organization to turn to *now*, and if I understand them correctly, they do not want the union kind.

The E. J. C. has been very slow in getting under the weight of this concern but it is now aroused and I believe its Manual on Collective Bargaining and its two economic surveys are worth waiting for and will indicate the next steps that should be taken. The new A.S.M.E. Committee just described will help implement this matter.

I am convinced that mechanical engineering is a profession and that some of our finest energies must be directed continually toward maintaining and increasing our availability as a profession for helping to solve postwar problems of the economic status of engineers.

I believe as individuals and as a Society we are not opposed to labor unions. They have their important functions to perform and are now an established part of our industrial structure.

Again may I say, our countrymen are expecting much of us today because the engineer is such a vital factor in the complicated life of the nation. As we continue to work for and in our profession "let us remember that old, old theme which has never lost its power and which may yet save a sorry world—*simple ministration to the people.*"

Automobile Industry Honors Col. Herbert W. Alden

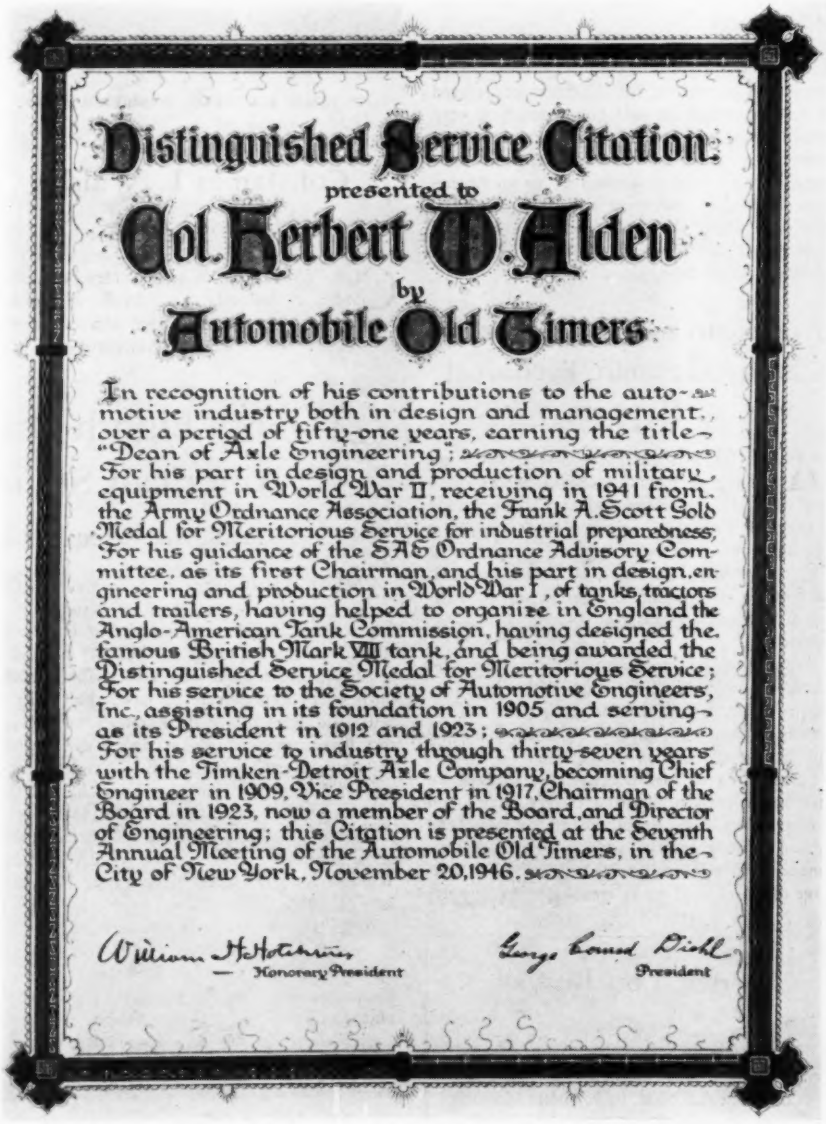
Paul D. Hoffman Speaks

COL. HERBERT W. ALDEN, fellow A.S.M.E., director of engineering, Timken-Detroit Axle Company, Detroit, Mich., was honored by the Automobile Old Timers, a national organization of motorcar pioneers, at their seventh annual luncheon held at the Roosevelt Hotel, New York, N. Y., Nov. 20, 1946.

Colonel Alden was presented a Distinguished Service Citation, an illuminated scroll upon which was inscribed the following tribute:

"In recognition of his contributions to the automotive industry, both in design and management, over a period of fifty-one years, earning the title, 'Dean of Axle Engineering.'

"For his part in design and production of military equipment in World War II, receiving in 1941 from the Army Ordnance Association, the Frank A. Scott Gold Medal for Meritorious Service for Industrial Preparedness; for his guidance of the S.A.E. Ordnance Advisory Committee, as its first chairman, and his part in design, engineering, and production in World War I, of tanks, tractors, and trailers, having helped to organize in England the Anglo-American Tank Commission, having designed the famous British Mark VIII tank, and being awarded the Distinguished Ser-


Distinguished Service Citation
presented to
Col. Herbert W. Alden
by
Automobile Old Timers

In recognition of his contributions to the automotive industry both in design and management, over a period of fifty-one years, earning the title "Dean of Axle Engineering"; For his part in design and production of military equipment in World War II, receiving in 1941 from the Army Ordnance Association, the Frank A. Scott Gold Medal for Meritorious Service for industrial preparedness; For his guidance of the SAE Ordnance Advisory Committee, as its first Chairman, and his part in design, engineering and production in World War I, of tanks, tractors and trailers, having helped to organize in England the Anglo-American Tank Commission, having designed the famous British Mark VIII tank, and being awarded the Distinguished Service Medal for Meritorious Service; For his service to the Society of Automotive Engineers, Inc., assisting in its foundation in 1905 and serving as its President in 1912 and 1923; For his service to industry through thirty-seven years with the Timken-Detroit Axle Company, becoming Chief Engineer in 1909, Vice President in 1917, Chairman of the Board in 1923, now a member of the Board, and Director of Engineering; this Citation is presented at the Seventh Annual Meeting of the Automobile Old Timers, in the City of New York, November 20, 1946.

William H. Holcomb — Honorary President
George Conrad Diehl — President

CERTIFICATE PRESENTED TO COL. HERBERT W. ALDEN BY THE AUTOMOBILE OLD TIMERS

vice Medal for Meritorious Service; for his service to the Society of Automotive Engineers, Inc., assisting in its foundation in 1905 and serving as its president in 1912 and 1923; for his service to industry through thirty-seven years with the Timken-Detroit Axle Company, becoming chief engineer in 1909 and serving as its president in 1912 and 1923; for his service to industry through thirty-seven years with the Timken-Detroit Axle Company, becoming chief engineer in 1909, vice-president in 1917, chairman of the board in 1923, now a member of the board and director of engineering; this citation is presented at the Seventh Annual Meeting of the Automobile Old Timers in the City of New York, November 20, 1946."

Among those seated on the dais were: John A. C. Warner, member A.S.M.E., secretary, S.A.E.; Charles H. Davis, member A.S.M.E.; Paul G. Hoffman, guest speaker, 1946 Gantt Medalist, and president, The Studebaker Corporation; George C. Diehl, president, A.O.T.; Ransom E. Olds, and Alfred Reeves.

Following a tribute to the automobile industry for its leadership in the world of trade and commerce, Mr. Hoffman considered a subject which he said concerned him very much—the problem of the next American depression. He said that in Europe business men have reconciled themselves to an American depression and were speculating only on the date. Mr. Hoffman deplored "Universal and casual acceptance of the inevitability of another major depression."

American Industry Urged to Study German Technical Reports

AMERICAN investigators in Germany are passing over much technical information of value to American industry because the Office of Technical Services in Germany is undermanned and lacks experts to uncover or interpret much of the technical data discovered, according to William E. Darrow, chief, utilities, Technical Industrial Intelligence Division.

American organizations who could gain from knowledge of German technology are urged to send their own investigators to Germany at their own expense to aid in the work of the Government investigators.

According to Mr. Darrow, the mass of information still undigested covers Diesel and electrical-railway developments, steam- and gas-turbine research, and mechanical-equipment designs for industrial waste control, sewage disposal, and water treatment and supply.

Are You Busy?

Too busy for Section meetings? Ever dream of the "green years?" "You are missing plenty" if you do not read A.S.M.E. news about Sections and the activities at your alma mater.

COL. JAMES L. WALSH, MEMBER A.S.M.E.

Col. James L. Walsh Heads A.O.A.

COL. JAMES L. WALSH, member A.S.M.E., chairman, A.S.M.E. National Security Committee, has been elected president of the Army Ordnance Association, it has been announced. He assumed his new duties on Jan. 1, 1947.

By the election of a new president the A. O. A. terminated an old policy of continuity in the presidential office. Colonel Walsh is not expected to hold office for more than two years.

Colonel Walsh has been active in the A.S.M.E. for many years. As chairman of the A.S.M.E. National Security Committee, during the early years of World War II, he did much to jar the complacency of the nation by his papers and talks on "Logistics—The Science of Survival." Many members will recall Colonel Walsh as a hard-hitting speaker who held the interest of his audience during the question period long after the conclusion of his prepared talk.

After World War I, Colonel Walsh helped to found the Army Ordnance Association as an organization to preserve the great fund of ordnance information developed during the war and to encourage further development. In 1920 he founded the magazine *Ordnance Magazine* and for two years served as its editor.

Colonel Walsh was elected chairman of the A.S.M.E. National Defense Division when it was organized in 1928. When disturbing news from Europe again called attention to national security, Colonel Walsh was called to organize an A.S.M.E. program. As head of the A.S.M.E. National Defense Committee, later called War Production Committee, he traveled across the nation organizing and conducting war-production clinics in industrial centers and speaking on the Army problem of logistics.

Colonel Walsh is a holder of the Distinguished Service Medal.

Twenty-Eighth Annual Meeting of the American Standards Association

A.S.M.E. Member Elected Vice-President

AMERICAN industry is not only turning to standards as a tool of management and a protection for consumers but is giving liberal financial support to the 1947 program of the American Standards Association, which outlines an expenditure of more than a half million dollars in the development of voluntary American standards, according to Howard Coonley, associate A.S.M.E., chairman, executive committee, A.S.A., who spoke to 1000 business and industrial executives and representatives of consumer-group industries at the 28th annual meeting of the A.S.A. at the Waldorf-Astoria Hotel, New York, Nov. 21 and 22, 1946.

Reporting on a recent nation-wide tour of industrial centers during which he spoke to executives, Mr. Coonley said that he was convinced that "industry realizes the importance of its stake in standardization" and that "when business has an opportunity to contribute to the well-being of the nation, that opportunity will not go by default."

Election of Officers Announced

Frederick R. Lack, vice-president, Western Electric Company has been elected president of the Association for 1947, it was announced, and George H. Taber, Jr., member A.S.M.E., executive vice-president, Sinclair Refining Company, vice-president.

A.S.A. Assuming New Role

Henry B. Bryans, retiring president A.S.A., reported that progress during the past year was assuming the new role in American standardization assigned to it by the Secretary of Commerce in February, 1946, when the relative roles of government and industry in the development of American standards were clarified.

Standard Sponsored by A.S.M.E. Cited

L. F. Adams, acting chairman, A.S.A. Standards Council, in a review of the 1946 activities, called attention to the new standard B5.19 Life Tests of Single-Point Tools Made of Materials Other than Sintered Carbides, as the eighteenth standard by the A.S.A. Committee on Small Tools and Machine Tool Elements, whose work is of fundamental im-

portance to the mass-production industry. He said:

"The new standard establishes for the first time a uniform basis of rating the useful life to be expected of this type of cutting tool. These cutting elements are vital parts of such machine tools as lathes, boring mills, planers, and shapers. Until the work of this Committee was completed, users of such cutting elements lacked a reliable basis for setting up production schedules based on the life of these tools."

This standard was sponsored by The American Society of Mechanical Engineers in cooperation with the Society of Automotive Engineers and the National Machine Tool Builders' Association.

Emergency War Standards

According to Mr. Adams, the A.S.A. is reviewing the 153 standards adopted during the war as Emergency War Standards in order to determine how much of the technical work done on these projects can be made available for peacetime use. To date, he said, 15 have been reconsidered and affirmed as peacetime standards.

Southwest to Be Scene of A.S.M.E. 1947 Spring Meeting

WHILE most members of the Society are still evaluating the papers and talks of the 1946 Annual Meeting, W. Fred Stewart, chairman, A.S.M.E. Mid-Continent Section, is well ahead with local plans for the A.S.M.E. 1947 Spring Meeting in Tulsa, Okla., March 2 to 5, 1947.

In keeping with the tremendous industrial gains made by Tulsa during the war, when more than 300 of the 482 peacetime factories were engaged in production of critical war materials, the theme "Industrial Development of the Southwest" has been chosen for the Spring Meeting.

The hotel situation, which has annoyed the Meetings and Program Committee during recent national meetings of the Society, promises, in Tulsa to be a matter only for reminescence. Tulsa has 18 first-class hotels which provide 3000 guest rooms. Air-travel facility to Tulsa will make the city close to the northern cities of the country.

Mr. Stewart is planning a program of plant trips to local refineries, laboratories, and manufacturing concerns which will show the diversity of Tulsa's industrial interests. Some consideration is being given to technical sessions at some of the plants for convenience of visitors.

The arrangements committee of the Mid-Continent Section for the 1947 Spring Meeting follows: treasurer, Carl Stevens; registration, Clarence Glasgow; hotel arrangements, W. E. Bauman; technical sessions arrangements, F. J. Daasch, chairman, C. H. Blue, W. B. McDermott, and W. C. Moody; finance, Orval Lewis; publicity, Jim Wilson and R. B. Tuttle; social and ladies' entertainment, Mr. and Mrs. G. McConnell; entertainment, A. J. Hanssen; plant trips, R. A. Colgin, chairman; welcome committee, L. T. Gibbs, chairman, D. Cant, John Keyes, and D. O. Johnson.

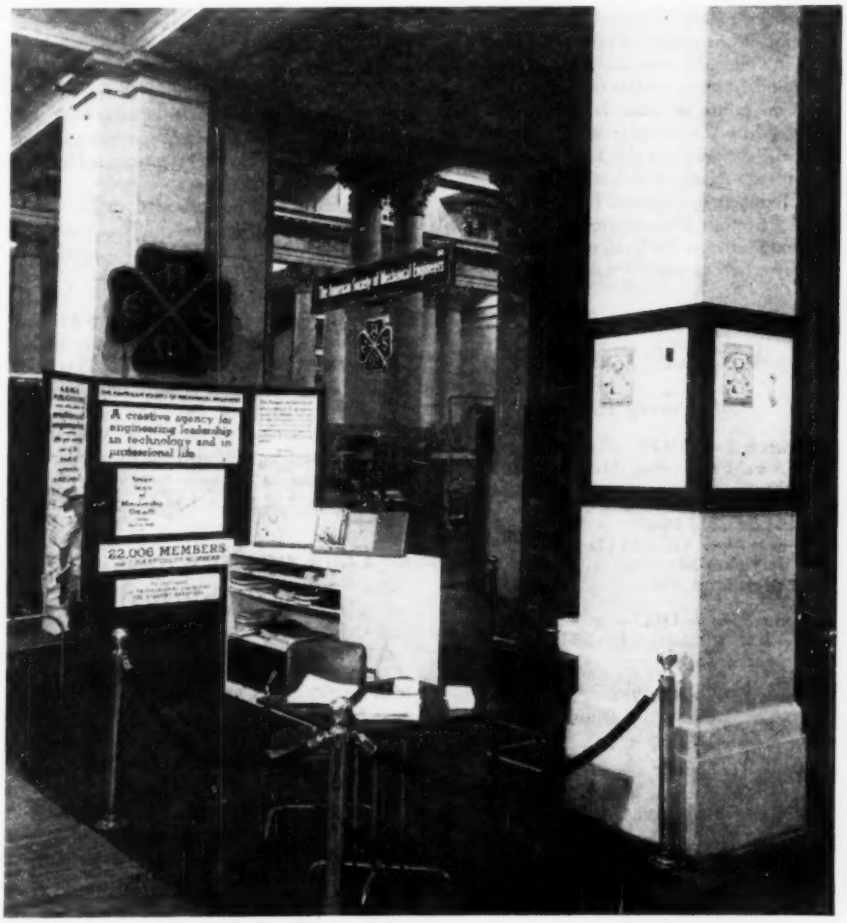
W. FRED STEWART, CHAIRMAN, A.S.M.E. MID-CONTINENT SECTION

17th National Exposition of Power and Mechanical Engineering

THE Seventeenth National Exposition of Power and Mechanical Engineering returned to its traditional location in Grand Central Palace, New York, N. Y., and was held during the week of December 7, 1946. It was a huge success having a record attendance of over 51,000 visitors during the week. With nearly 400 exhibits crowding all the available space on four floors, the exposition covered every conceivable kind of industrial activity. The range of exhibits displayed was complete, from boilers, stokers, pumps, fans, valves, to insulation, steam specialties, metals, welding, transmission and materials-handling apparatus, precision instruments, power and hand tools, and many other products.

The exhibit of The American Society of Mechanical Engineers at Booth No. 80 was one of the most popular displays at the show. Prominently located, equipped with books and publications, comfortably furnished, and well staffed, the booth was the meeting place of members of the Society and for visitors seeking knowledge, information, and rest.

The 1946 exposition was organized with the


The American Society of Mechanical Engineers
A creative agency for engineering leadership in technology and in professional life
22,006 MEMBERS

A.S.M.E. BOOTH AT THE 1946 POWER SHOW

primary purpose of aiding in power production and distribution, also of assisting in the furtherance of plans for the conversion of industrial plants back to civilian pursuits. The attendance throughout the period of the exposition was made up of business executives, plant managers and superintendents, chemists, metallurgists, chief engineers, designers, research directors; civil, mechanical, electrical, and mining engineers, and many others.

Walter Ramberg Appointed Bureau of Standards Section Chief

THE appointment of Walter Ramberg, member A.S.M.E., as chief, Engineering Mechanics Section, National Bureau of Standards, was announced by E. U. Condon, director. Dr. Ramberg succeeds H. L. Whittemore, fellow A.S.M.E., who recently retired after 29 years' service.

Dr. Ramberg is noted for his work in aeronautical research, especially in the field of aircraft structures. He has contributed to scientific literature on the strength of materials, the strength and instability of structural elements of aircraft, and the vibration of propellers. The most recent of a number of vibration-measuring instruments developed by Dr. Ramberg is an electronic tube known as a vacuum-tube acceleration pickup, designed to record rapidly changing accelerations of portions of an airplane in flight and now proving useful to the Army and Navy in studies of acceleration imposed on pilots in crash landings. For his "outstanding achievement in the engineering sciences," he received the 1942 award of the Washington Academy of Sciences.

Dr. Ramberg is a member of the Subcommittees on Aircraft Construction and on Vibration and Flutter of the National Advisory Committee for Aeronautics. He is also a member of the Institute of Aeronautical Sciences, Society for Experimental Stress Analysis, Washington Academy of Sciences, and the Philosophical Society of Washington.

WALTER RAMBERG, MEMBER A.S.M.E.

A.S.M.E. Calendar

of Coming Events

March 2–5, 1947
A.S.M.E. Spring Meeting
Tulsa, Okla.

May 21–24, 1947
A.S.M.E. Oil and Gas Power Division Meeting
Cleveland, Ohio

June 12–13, 1947
Wood Industries Division Meeting
Madison, Wis.

June 16–19, 1947
A.S.M.E. Semi-Annual Meeting
Chicago, Ill.

Sept. 1–4, 1947
A.S.M.E. Fall Meeting
Salt Lake City, Utah

Dec. 2–5, 1947
A.S.M.E. Annual Meeting
New York, N. Y., or
Atlantic City, N. J.

Vannevar Bush to Receive Hoover Medal

VANNEVAR BUSH, president, Carnegie Institute of Washington, and wartime director of the Office of Scientific Research and Development, has been named to receive the Hoover Medal by the board of awards of the Founder Engineering Societies in recognition of his public service as engineer, educator, and administrator.

The award will be presented to Dr. Bush at the winter convention of The American Institute of Electrical Engineers, Engineering Societies Building, New York, N. Y., Jan. 27–31, 1947.

The Hoover Medal was founded in 1929 to commemorate the civic and humanitarian achievements of Herbert Hoover. The trust fund creating the award is a gift of Conrad N. Lauer of Philadelphia, Pa. The fund is held by The American Society of Mechanical Engineers and is administered by a board of award consisting of three members from the A.S.C.E.; A.I.M.E.; A.S.M.E.; and A.I.E.E.

Data on New Steels to Be Published

A series of books recording the advances in ferrous metallurgy made during the war will be published by the Alloys of Iron Research, a major research project of The Engineering Foundation, which is a division of the United Engineering Trustees, Inc., it has been announced.

The first volume, now in preparation, will contain a description of the characteristics and properties of many new alloy steels and a summary of new principles of plastic deformation at elevated temperatures which have proved of value in developing new steels for high- and low-temperature use, as in jet-propelled airplanes that operate at high altitudes where temperatures are low.

The new series will complement the eleven comprehensive monographs which represent the work of the Alloys of Iron Research project completed prior to the war.

Frank T. Sisco, editorial director of the new series, described the first volume as follows: "There will be chapters on what might accurately be called the new science of metallurgy, including a precise understanding of the structural changes in the solid state that underlie our present knowledge of how steels harden when they are rapidly cooled and how the hardenability of the various steels can be correlated with chemical composition."

How Many Trips?

AS president of the A.S.M.E. during 1946, D. Robert Yarnall traveled the length and breadth of the land speaking to engineers about professional and Society affairs. His insight into and his understanding of the aspirations of engineers enabled him to clarify many fundamental questions facing the engineering profession, but he often sent his engineering audiences home with brows furrowed, heads lowered, hand in pockets, in short, deeply perplexed.

The question Mr. Yarnall posed was this: Given a long box with a hole at each end and a black cat inside. The cat puts his head out of one end of the box, then runs to the other end to put his head out of the other hole. If he runs at a speed of 10 miles per hour and doubles his speed each succeeding trip, how many trips will he have to make before he can put his head out of both holes at the same time?

Largest Cyclotron Ready for Service

THE world's mightiest atom smasher, the 4000-ton 184-in. cyclotron, built by the Radiation Laboratory, University of California, Berkeley, Calif., under the supervision of E. O. Lawrence, inventor of the cyclotron, Nobel Prize winner in physics in 1939, and A.S.M.E. Holley Medalist, 1942, was inspected last month by the United States Atomic Energy Commission headed by David M. Lilienthal, just two weeks after the big machine was completed.

Construction of the cyclotron, the third to be built at Berkeley, was commenced in 1940. The Manhattan District showed immediate interest in the project and construction work was halted when the 3700-ton electromagnet was diverted to research in the electromagnetic separation process for uranium 235 in development of the atomic bomb.

With the end of the war, work on the cyclotron was continued, and on Nov. 1, 1946, Dr. Lawrence announced that except for synchronization of some of the auxiliary equipment the cyclotron was ready for service.

Dr. Lawrence expects the new machine to energize protons of positively charged atomic particles to 350,000,000 electron volts, and alpha particles, or hearts of helium atoms, to 400,000,000 electron volts.

A.S.M.E. Nominating Committee Receiving Proposals for National Officers

THE 1947 National Nominating Committee of the Society is now receiving proposals for candidates for the offices to be filled during 1947, which are as follows:

President	To serve 1 year
Vice-President	To serve 2 years Region I
Vice-President	To serve 2 years Region III
Vice-President	To serve 2 years Region V
Vice-President	To serve 2 years Region VII
Directors at Large (2)	To serve 4 years
Director at Large (1)	To serve 3 years*

Early Action Requested

Proposals from the Society's membership will be welcomed by the Committee, and those who intend to submit them are urged to act *promptly*. Candidates' names and records should be submitted on the official proposal form which may be obtained from any member of the Nominating Committee as listed below. Completed forms should be sent to the Committee through its Secretary, L. J. Cucullu, c/o New Orleans Public Service, Inc., 317 Baronne St., New Orleans, La., not later than April 1, 1947.

Before submitting the name of a candidate, his consent to serve should be obtained by the proposer. The proposer, not the candidate, should fill out the form. Members are reminded that, in accordance with the Society's Constitution, candidates for the office of President, Vice-President, and Director at Large shall be of the Grade of Fellow or Member of the Society.

Members wishing to orally support the candidacy of a proposed nominee will be given an opportunity to do so at the Committee's open hearings in Chicago during the Society's Semi-Annual Meeting.

1947 National Nominating Committee

Region I

L. J. Hooper, Worcester Polytechnic Institute, Worcester, Mass.
L. C. Smith, *1st Alternate*, Spencer Turbine Company, Hartford, Conn.
James A. Powell, *2nd Alternate*, Stone and Webster Engineering Corporation, 49 Federal St., Boston, 7, Mass.

Region II

J. H. Sengstaken, Western Precipitation Corporation, 405 Lexington Avenue, New York, N. Y.
R. W. Flynn, *1st Alternate*, Gulf Oil Company, 17 Battery Place, New York, N. Y.
Harold C. R. Carlson, *2nd Alternate*, Lee Spring Company, Incorporated, 30 Main St., Brooklyn 1, N. Y.

REGION III

R. C. Dannettel, Consolidated Gas Electric Light and Power Company, Baltimore, Md.
F. S. Erdman, *1st Alternate*, College of Engineering, Cornell University, Ithaca, N. Y.
P. C. Osterman, *2nd Alternate*, American Gas Furnace Company, Spring & Lafayette Sts., Elizabeth, N. J.

REGION IV

Prof. J. B. Jones, *Chairman*, Virginia Polytechnic Institute, Blacksburg, Va.
Paul R. Yopp, *1st Alternate*, Babcock and Wilcox Company, 1203 Candler Bldg., Atlanta 3, Ga.
Prof. J. Mack Tucker, *2nd Alternate*, University of Tennessee, Knoxville, Tenn.

REGION V

J. G. Martin, Babcock and Wilcox Company, 2511 Carew Tower, Cincinnati, Ohio
M. R. Bowerman, *Alternate*, Homeworth, Ohio

REGION VI

Prof. Huber O. Croft, University of Iowa, 122 Engineering Bldg., Iowa City, Iowa.
R. W. Merkle, *1st Alternate*, 112 Springer Ave., Edwardsville, Ill.
C. F. Moulton, *Alternate*, Nebraska Power Company, 4th. & Jones St., Omaha, Neb.

REGION VII

Ray G. Roshong, 4855 Gentry Avenue, North Hollywood, Calif.
H. E. Prescott, *1st Alternate*, Golden State Company, 425 Battery St., San Francisco, Calif.
Ivan A. Shirk, *2nd Alternate*, 231 Waverly Place, Spokane 13, Wash.

REGION VIII

L. J. Cucullu, *Secretary*, New Orleans Public Service Incorporated, 317 Baronne St., New Orleans 9, La.
O. L. Lewis, *1st Alternate*, Jones and Laughlin Supply Company, 108 N. Trenton, Tulsa 4, Okla.
G. H. Woelbing, *2nd Alternate*, Silver Engineering Works, Inc., 3309 Blake St., Denver, Colo.

* To serve unexpired term of B.V. E. Nordberg, deceased.

United Engineering Trustees Report for 1945–1946

Summary of Facts Concerning Finances, Building, Engineering Societies Library, and Engineering Foundation

THE Annual Report of the United Engineering Trustees, Inc., for 1945–1946 was issued on Oct. 24, 1946, by President J. P. H. Perry. Mr. Perry's report in somewhat abridged form follows:

Forty-Second Year

Since Oct. 1, 1945, the beginning of the forty-second corporation year, the struggles of the world in trying to readjust itself to peace after six years of widespread war of the most vicious character in history have been reflected in the activities about us. Returning service men have sought advice in our offices on obtaining jobs, on how to secure an engineering education, or in continuing interrupted technical instruction. Others have sought to increase their knowledge in our library. All of our societies have welcomed returned members and new applicants who have served in the armed services. In our operations, labor demands, prices of maintenance materials, difficulty in obtaining necessary materials—all these and more, have brought close to us the troubled times about us. Within reasonable limits, we believe we have been successful in carrying on to the best advantage for our societies.

Engineering Societies Building

The principal problem has been the matter of more adequate housing for the Founder Societies and those Associates who have cast their lot with us. The need for additional area has forced two of our Founder Societies to take considerable space in adjacent buildings. Many committees in the past have probed into the possibilities of enlarged operating space. The history of their activities shows a three-story addition to the building in 1916–1917, ten years after the Engineering Societies Building was dedicated. Three years later our predecessors very nearly purchased an adjacent building (the Haskins & Sells Building, 35–37 West 39th St.) which would have added 35,000 square feet to our office space. In another ten years, elaborate plans were made for a building with 630,000 square feet on our present site. Again in five more years, in the middle thirties, committees were established to attempt to solve our expansion problems. Since June last a similar committee has been at work on studies for the Founder Societies' approval which may develop into plans which will furnish them the increased space they so urgently need, whether in the present building with reconstruction, and perhaps acquisition of adjacent properties, or in a new building at a different location. There are important fundamental issues to be weighed involving decisions on policy before expansion plans can progress further.

The building is fully occupied by the four Founder Societies and nine Associates, with demand for an additional 10,000 square feet at once, and still more in the coming five and ten years.

Engineering Societies Building and land are carried on the books at $1,993,793.92, against which we have a depreciation fund of $585,721.63. This fund is inadequate for depreciation (obsolescence) of a forty-year-old building, and is not large enough to be a real contribution toward replacing or rebuilding the present structure.

The building remains exempt from taxation, with an assessed value of $910,000, of which the land is valued on the City tax rolls at $410,000, leaving $500,000, as a "value" of the structure.

The building, designed in the early days of the century, followed the classic lines and is difficult to adapt to present sound office practice. The high ceilings consume light and heat. Illumination is gradually being modernized. We may expect a general demand for air-conditioned space in the future.

The building is in excellent condition notwithstanding its age. The ravages of time have shown in such points as water pipes, for which some replacement has been necessary again in the past year. Elevators have required more than usual attention, with some fairly costly machine parts renewed. A minimum of such work is being done—since it is desirable to postpone whenever possible such work inasmuch as there are under way plans for rehabilitation or reconstruction. Another and major item facing us if we remain here, is a complete job of refenestration.

A recent inspection by our fire-insurance carriers assures us that fire hazards are kept at a minimum and that the general housekeeping is excellent.

Operating Costs

Operating costs are largely labor costs. In a building in use from early morning until nearly midnight five days each week, and on Saturday until six o'clock, service costs, heat, light, and other essentials are necessarily higher than in commercial buildings of comparable size. To this is added the operation of meeting halls requiring cleaning and often rearrangement of seats between meetings, and the care of the marble corridors, lobbies, staircases—all these require special service. These are a part of Engineering Societies Building, whether luxuries or not in today's standards, and are considered in keeping with the professional tradition of the premises. The building staff—operating, maintenance, and cleaning personnel—numbers 29 with an annual pay roll (including overtime) of $59,900. The library staff includes 25 with pay roll of $57,600. The Foundation with part-time Director and Secretary, grouped with the administrative staff, bring the total number of employees of the United Engineering Trustees, Inc., to 61, with a total pay roll of $131,700.

Employee Retirement Plan

The staff is composed largely of employees who have been in our service (the service of the Founder Societies) for many years, some for more than thirty years. The problem of retirement benefits for these loyal employees will require solution in the near future. Four retired employees now receive a retirement allowance totaling $2665 yearly. An early enforced retirement is in prospect for two employees recently active and with many years' past service, which will bring our budget retirement allowance to $4350 during this coming fiscal year. We hope our Founder Societies may reach an early agreement authorizing a formal pension plan for the Corporation employees which will relieve our building budget of this item. Three of the Founder Societies have pension plans in operation for their staffs only.

Financial Matters

Investments. The assets of the Corporation, besides the value of Engineering Societies Building and its Depreciation Fund, consist of the corpus of gifts made to create income for certain specific purposes: To finance researches in technical subjects sponsored by the Founder Societies; or "for the advancement in any other manner of the profession of engineering and the good of mankind;" or to operate Engineering Societies Library. These funds, while the actual property of the Corporation, really constitute a trust. The preservation of the original value of the gift is taken most seriously by the Trustees, who realize at the same time, that without income the gift fails to carry out the purposes of the donor. We have been fortunate in having steadily improved the quality of our portfolio, and at the same time obtained income of an acceptable rate for the times.

The Finance Committee, assisted by a highly reputed investment adviser, has watched the portfolio closely. War and postwar conditions have not been conducive to extensive buying or selling, and it has been deemed best in some cases to hold some cash liquid against any market advantages which might appear. The accompanying balance sheets and operation reports give a clear picture of the condition and operations of the Corporation.

Professional Advisers. Among the professional advisers of the Board of Trustees, are Wood, Struthers & Company, investment advisers (referred to); W. Barton Cummings, Vice-President, Chemical Bank & Trust Company, financial counsel to the Board of trustees; Carter, Ledyard & Milburn, legal counsel; Shreve, Lamb & Harmon, consulting architects; Frank & DuBois, insurance counselors; Haskins & Sells, certified public accountants.

Building Depreciation Reserve. The Depreciation Fund shows its importance as we study the enlargement of our headquarters, with the urgent need of ready cash. Each year $20,000 is added from building income, which with the interest from investments added $36,406.41 during the fiscal year just past, bringing its total value on Sept. 30, 1946, to $585,721.63.

Service to Related Organizations. The Corporation holds titular ownership of the funds of the John Fritz Medal Board of Award, and

the Daniel Guggenheim Medal Board of Award, managing them for these boards. It acts as treasurer for the Engineers' Council for Professional Development. It also holds in custody contributions for Engineering Foundation research projects, disbursing from them on proper authorization.

Audit. Haskins & Sells, certified public accountants, audited our books for the fiscal year just ended, and rendered a certificate, verifying the correctness of the books and all transactions.

The aggregate book value of our capital fund investments on Sept. 30, 1946, the close of our fiscal year, was $1,669,297.44. The market value on or about that date was $1,753,516.51 or 105 per cent of book value. The previous year showed 106½ per cent of book value.

The titular ownership of Engineering Societies Building added to these funds represents a custody of assets amounting to upward of $3,500,000 for the engineering profession through the Founder Societies.

Increase of Funds. The principal funds of Engineering Societies Library, amounting to $216,530, and those of the Engineering Foundation totaling $944,242, produce insufficient income to conduct the business of these important organizations in a manner befitting the engineering profession. It is sincerely hoped that in the consideration given to improving our building an increase of funds for the work of these two departments may be effectuated at the same time. In any campaign for funds for Engineering Societies Building, Engineering Societies Library might be a great lever to interest possible donors.

Legal Counsel

Our good friend of many years' legal service to the Corporation and to three of the Founder Societies, Charles Adkins Baker, of Parker and Aaron, died on Dec. 7, 1945. Mr. Baker always had at heart the interests of the engineering profession and its principal societies. He was with his law firm as a young man when they wrote our Charter in 1904. His clear advice has guided us over the years since. His loss is keenly felt.

Through a committee, in conjunction with the Founder Societies, we have studied the matter of legal advisers and have appointed the firm of Carter, Ledyard, and Milburn of New York, N. Y., as legal counsel to the Corporation, effective Oct. 1, 1946.

Possible Wider Usefulness

Back in 1904 the Founder Societies felt the need for one organization to function for them jointly. To accomplish this they organized United Engineering Trustees, Inc., chartered "for the advancement of the engineering arts and sciences in all their branches and to maintain a free public engineering library." The breadth of this Charter offers to the Founder Societies much greater use than they at present make of this joint organization. With our membership made up exclusively of appointees of the Founder Societies whose interests reflect those of the Societies, we are in a most favorable position to accept more assignments by the Societies. It is earnestly hoped that advantage will be taken of our functional possibilities, and that the Societies will call upon us further.

Engineering Societies Library and Engineering Foundation

The extent of the activities of Engineering Societies Library is not generally realized by the membership of the Founder Societies. During the past year more than 23,000 visitors worked in the library. In addition, nearly 15,000 were served by mail and 6700 by telephone; 4000 orders for photostats required furnishing 48,000 prints; translations from foreign-language technical publications totaled more than 218,500 words; and 1250 persons borrowed books from our library. Exclusive of orders for books, 2500 letters were written in reply to requests for information. As a basis for this assistance to readers, our library has more than 190,000 volumes, maps, and pamphlets, more than 10,000 having been added during the past year.

Engineering Foundation has a very limited income from capital funds given to finance research for "the advancement of the profession of engineering and the good of mankind." The wisdom displayed in the allocation of this income is indicated in the national importance of many of the projects, some of which were taken over in part by the Government as aid in the successful prosecution of the war. The policy of the Foundation is to start a research on an apparently needed subject, carrying it to the stage where its value attracts adequate contributions from industry. One project begun by the Engineering Foundation alone with only several thousand dollars now operates on a yearly budget of more than a quarter million dollars, subscribed by industrial corporations. The Foundation is therefore frequently referred to as a "catalyst."

Reports by the Directors covering in detail the work of these departments of the Corporation, reviewing their accomplishments during the past year, are appended.

Engineering Societies Library

IN his annual report to the Library Board Ralph H. Phelps, acting-director, Engineering Societies Library, New York, N. Y., stated:

"The use of the Library this year has been 15 per cent greater than last year. On the average, 130 persons have been helped by the Library each day. All services have been used more except the photostat service which has decreased by about 9 per cent. This is not surprising, for it had experienced a very abnormal growth during the war.

"This has been a year of change, uncertainty, and difficulty. There have been staff changes, and supplies, equipment, and binding have been uncertain and hard to get. Books, magazines, and reports unavailable during the war are now coming in a rapidly increasing flood that will continue for some time. The nineteen members of the staff have done the increased work cheerfully and well, although at times, service is not as quick or as thorough as desired. The staff should be increased in number."

Use by Non-Visitors

The requests of the non-visitors for loans of specific books, advice as to the best or most recent book on a specific subject or in a specific field, sources of information, specific data on manufacturing problems, and miscellaneous appeals, each requires on the average more library-staff time than would be needed if the inquirer came to the Library. In this respect, non-visitors are receiving a much greater service relative to that received by visitors than would be indicated by the ratio of the numbers of each, so that it is certainly not true that those living in the metropolitan area benefit much more by Library expenditures than those living beyond visiting distances."

The above paragraph from the latest report of the A.S.M.E. Library Committee is an excellent statement of the value of the Library to nonvisitors.

Personnel

On Feb. 1, 1946, Dr. Harrison W. Craver, director of the Library since 1917, became consulting librarian. At the same time, Ralph H. Phelps was made acting director.

Five members of the staff are over fifty years of age. Social Security is not available to employees of nonprofit organizations. Some retirement plan should be established as soon as possible. Miss Catherine O'Kane will complete forty years of service in February, 1947. Several others have long employment records, three being over twenty-five years.

Miscellaneous Activities and Events

A dinner honoring Dr. Craver was held May 22, 1946, at the Engineers' Club. Those present included present members of the United Engineering Trustees, Inc., and members of the Library Board since 1940.

The Library received $10,000 from the estate of W. S. Barstow. This was added to the Endowment Fund. The interest from this fund and the receipts from a large sale of duplicate books, together amounting to over $2000, provided an unexpected addition to operating revenue. Contributions from other engineering societies, although small in comparison with funds supplied by the Founder Societies, are very helpful and are much appreciated.

More than 4000 duplicate books and periodicals from the collection of John R. Freeman were made available to the International Relations Committee of the Engineers Joint Council. Most of the books were shipped to China, but others went to libraries in various countries. These shipments were made through the American Book Center.

During the year, your acting director attended the meetings of the Building Planning Committee. Space requirements have been calculated for the Committee, but no specific action has been taken beyond that.

The Association of Research Libraries this year dropped the Engineering Societies Library from its membership. This action was taken after a survey disclosed that this Library spent much less for books and magazines than other libraries in the Association. This Library has always been able to operate with a small expenditure for books, because it has been particularly favored by gifts of recent publications. Having a relatively narrow field to cover, compared with the very large libraries that compose the Association of Re-

search Libraries, it has been able to keep abreast of affairs in its field, engineering. It is becoming increasingly difficult to do so, owing to increased research activity in its field, and the question of its adequacy needs careful review by the Board.

At the direction of the Library Board, your acting director made a survey of salaries of other libraries and of the Founder Societies. Engineering Societies Library salaries were lower than others. Adjustments have been made and, at least for the moment, salaries are comparable.

Engineering Index cards for the current year are now filed in the Reading Room. This makes this valuable index immediately available to members and engineers, which has not been the case before.

New lights for the photostat machine and a new photoprint drier are now in operation. This equipment, unavailable during the war, should eliminate much of the trouble experienced with this equipment during recent years.

Promotion of Library Services

A folder describing the services of the Library was prepared and printed and several thousand copies have been distributed. It is a great help in answering the many inquiries about the services of the Library. The folder has been reprinted in the journals of three Founder Societies and will soon appear in the journal of the other Founder Society.

Acquisitions

During the year, 10,739 volumes, pamphlets, maps, etc., were received; of these, 6665 were added to the Library. (These are respectively 15 and 23 per cent greater than last year.) The remainder, being duplicates or works of no value to us, were given to other libraries or reserved for sale or exchange as opportunity arises.

The Library entered into negotiations for thousands of foreign books and also all Office of Scientific Research and Development reports. As the year ended several cases were received, but not opened and counted.

The total resources at the close of the year were 161,884 volumes, 10,063 maps, and 4838 searches; a total of 176,785 items.

During the year, a large number of gifts were received. The list is too long for insertion here, but mention should be made of gifts from M. N. Baker through the American Water Works Association, George G. Berger, C. H. Brandes, R. H. Goodwillie, Edmund D. Haigler, John M. Lovejoy, James A. Rabbitt, George J. Taylor, and Prof. Edy Velander.

Other donors included The Franklin Institute, the General Cable Corporation, Lehigh University, the McGraw-Hill Publishing Company, Purdy & Henderson, *Railway Age*, Society of Automotive Engineers, the Alloys of Iron Research, the American Society for Metals, the American Society for Testing Materials, the American Water Works Association, the British Information Services, and the Society of Naval Architects and Marine Engineers.

Our Sincere thanks are extended to these and many others who enriched the collection.

Finance

The budget for general operation was $58,200 of which the following amounts were provided by the Founder Societies on a membership basis:

American Society of Civil Engineers	$11,006.00
American Institute of Mining and Metallurgical Engineers	8,492.30
American Society of Mechanical Engineers	10,385.60
American Institute of Electrical Engineers	11,541.20
	$41,425.10

Expenditures amounted to $51,838.61 of which $6,506.09 was spent for books, periodicals, and other equipment of permanent value.

Service Bureau receipts were $20,346.24 and expenses were $16,903.79.

The Engineering Foundation

IN their annual report to the United Engineering Trustees, Inc., A. B. Kinzel, chairman, and Edwin H. Colpitts, director, of The Engineering Foundation stated:

The accompanying financial statement summarizes the present capital funds of the Foundation, and the income and expenditures during the year. The book value of the capital funds of the Foundation on Sept. 30, 1946, was $944,242.28 as compared with $940,909.49 on Sept. 30, 1945. The income for the fiscal year 1945–1946 was $33,850.21 as compared with $34,536.89 for the previous year 1944–1945. For the fiscal year 1945–1946 disbursements amounted to $32,511.23 as compared with $28,675.22 for the year 1944–1945. The balance on September 30, 1946, was $48,215.50 as compared with $46,876.52 on Sept. 30, 1945.

As this report indicates, the Foundation has, during the year, continued its policy of supporting research projects in various fields of engineering and also certain agencies or activities having as their objective the advancement of the engineering profession. In selection of projects to be supported preference has continued to be given to those of a more fundamental nature which would not normally be undertaken by an industrial research organization. Where a project is of interest to a group of industries the Foundation has provided limited financial support and a sponsorship which enabled the main support of the project to be secured from industry or other sources. In general, it should be understood that the grant of the Foundation merely supplemented the contributions of the organization carrying on the research. Such contributions were space, testing facilities, technical direction of project, etc. Thus supplemented, relatively small grants from the Foundation were made most effective.

As to present-day conditions affecting industrial and scientific research, this country is faced with an immediate shortage of highly trained research personnel. This situation promises to be relieved in several years' time as large numbers of students are undertaking graduate work in the universities which, it may be added, are finding it difficult to secure adequate staffs due to the severe competition for trained men from Government and industry. It is clear that industry has, in general, become more research-minded and large expansions of industrial research are to be expected. In some cases this will be by individual companies, in others by associations of various types. The impact of this situation on our activities is being carefully considered.

Congress has not acted upon proposals for Government-supported research but meanwhile both of the Armed Services have undertaken to support large research projects under contracts with universities and industrial organizations. To what extent in the future and by what mechanisms Government will support research is still uncertain but it is reasonable to expect that whatever plan is finally adopted there will remain important areas where organizations such as the Foundation can serve provided their financial resources are adequate. Representatives of the armed forces are to be present at our annual meeting to discuss our relation to their work.

During the year 1945–1946 work under fourteen projects has continued and these are covered concisely in the following technical report. For the year 1946–1947 grants have been recommended to enable continuation of nine projects and for the initiation of four new projects.

The following projects are those in which the A.S.M.E. is particularly interested:

Special Research Committee on Lubrication, Project 23.

Chairman, B. L. Newkirk, department of aeronautical engineering, Rensselaer Polytechnic Institute, Troy, New York.

Objective: The Committee, during previous years, had sponsored a co-operative project at Harvard University for the study of the viscosity of lubricants under high pressure. This project had been discontinued and a discussion of ways and means of continuing this study indicated that the next step was to co-ordinate the published data in this field so that a project for further study could be prepared. The importance of the project derives from the fact that previous experience with heavily loaded bearings and gears indicates friction high enough to affect the viscosity of all lubricants. Therefore more information is needed on the viscosity under pressure. Preliminary to any experimental program the literature on this subject needs co-ordination to make it available for use in design and operation, and particularly for guidance in laying out the program for future study on the subject. The program contemplated for the year was a study of the literature. The survey and co-ordination of data was proposed to be covered in six reports as follows: (1) introduction and outline of past investigations, (2) methods of representation, with data on fatty oils, (3) data on mineral oils, (4) compounded oils and miscellaneous liquids, (5) correlation studies, and (6) empirical relations.

Progress: The Committee reports that the work of co-ordinating data on viscosity under pressure nears completion. The second half of progress Report 3 and Report 4 have been submitted. Reports 5 and 6, which will complete the study, are now in preparation. A paper describing this co-ordination was presented by Mr. Hersey at the 1945 Annual Meeting of the Society.

The Committee has voted to carry out a research program on viscosity-pressure relationships and a subcommittee is now working on the program and trying to find a satisfactory location and personnel to carry it out. The latter seems particularly difficult. It has also been decided to approach industry for funds to finance this program, but the actual solicitation of funds awaits completion of the program.

Also, some progress has been made during the past year on the lubrication bibliography. Abstracts of 11 papers on fluid film lubrication and similar abstracts of 18 papers in the field of boundary lubrication are now available.

A lubrication session was sponsored by this Committee at the 1945 Annual Meeting of the Society, when the following papers were presented:

(1) "Viscosity of Lubrications Under High Pressure," by M. D. Hersey and R. F. Hopkins.

(2) "Factors Influencing the Wear of Carbon Brushes Under High-Altitude Conditions," by W. E. Campbell.

(3) "Dimethyl Silicone Fluids and Their Performance Characteristics in Unilaterally Loaded Journal Bearings," by J. E. Brophy.

(4) "Dimethyl Silicone Fluids and Their Performance Characteristics in Hydraulic Systems," by V. Fitzsimmons, D. L. Pickett, W. O. Militz, and W. A. Zisman.

Fluid Meters, Project 30-b

Chairman, Special Research Committee on Fluid Meters, R. J. S. Pigott.

Objective: As would have been expected, the problem of measurement of pulsating flows has been one confronting industry for more than a few years. Seemingly, the problem was never satisfactorily solved. During the years 1936–1940, quite elaborate plans were made for continuing an investigational program and some progress was made in the development of instruments for determining whether or not meters were being affected by pulsation. The results of these investigations were presented at the Annual Meeting of the A.S.M.E. in 1943. The war very much limited any further activity. With the increased use of natural gas the problem of measuring flow subject to pulsating pressures, with flow meters, again becomes of major importance, and research with particular application to this problem seemed justified.

Progress: The work supported by the Engineering Foundation during the present year was assigned by the Committee to the University of Ohio. Due, however, to a serious overload in the University department concerned, relatively little was accomplished during the early part of the year. The results of the experimental work planned for the summer have not been announced or made available, so that it is not possible to report further.

The Committee sponsored a technical session at the summer meeting of the A.S.M.E. at Detroit when two papers, one on, "Pulsation and its Effect on Meters," by Eric J. Lindahl, and one on "Propeller-Type Meters," by I. O. Miner, were presented.

Stability of Steels as Affected by Temperature, Project 45.

Chairman, J. J. Kanter, materials research engineer, Crane Company, Chicago, Ill.

Objective: The work on the research project, "Stability of Steels as Affected by Temperature," was to be undertaken under the direction of the joint A.S.T.M. and A.S.M.E. research committee on effect of temperature on the properties of metals. The program for the specific research project involved studies dealing with the stability of carbon and alloy steels at high temperatures and over long periods of time. The first part of the work proposed involved the graphitization of carbon molybdenum and other steels such as those used in power-plant equipment. The results of the studies seem to be of benefit to the steel producers, to the manufacturers of power-plant equipment, to the operators of central stations and other power plants.

Progress: No report has yet been received covering the investigation of work which has been carried on at various manufacturing companies during the year but a report will be included in the amplified report.

Metal Cutting Data and Bibliography, Project 63.

Chairman, M. E. Martellotti, research engineer, Cincinnati Milling Machine Company, Cincinnati, Ohio.

Although during the present fiscal year the Engineering Foundation furnished no support to this project, it is a project the Foundation has previously supported and provision is made for its support during the coming fiscal year. It is therefore appropriate to include a brief statement covering the activities on this project which have continued during the present year.

Objective: The objectives of this A.S.M.E. Special Research Committee on Metal Cutting Data and Bibliography were twofold: namely, Revision of the Manual on Cutting of Metals and the preparation of a bibliography on cutting of metals. These projects were intended to supply engineering information in the field of metal cutting to those who are employed in the mechanical manufacturing industries or interested in metal cutting. There is no coordinated information available at the present time on the subject of metal cutting with the exception of the Manual on Cutting of Metals which was developed by the predecessor of this committee and published by the A.S.M.E. in 1939. In view of the progress made in recent years in the field of metal cutting the material contained in the first edition of the Manual needs to be revised and enlarged.

Progress: The chairman of the Committee reports that the progress on this project has been rather slow, because the Committee has insisted in seeing that the material to be eventually used in the new Manual be authoritative and in general agreement with the accepted theories and practices in the art of metal cutting. Many members, who have volunteered for this work, have been busy during the war on important projects, which did not permit them to devote more time to the work for the Manual. However, Part I and Part III are nearly completed, Parts II, IV, and V are now in process of compilation. Professor Gilbert and Professor Colwell of the University of Michigan, have agreed to compile the material for Parts IV and V and to conduct the necessary tests for the accumulation of additional data on the power required to cut metal.

Future Plans: As to future plans, the Committee has made contacts with various universities for the purpose of initiating research work on the cutting of metals and it is in this connection the support of the Engineering Foundation for the coming fiscal year has been requested.

Plastic Flow of Metals, Project 68.

Chairman, A. Nadai, Westinghouse Research Laboratories, East Pittsburgh, Pa.

This research program has been under way for some time under the general direction of the A.S.M.E. Special Research Committee on Plastic Flow of Metals. A survey of the literature discloses that although considerable research work has been done on rolling, very little of this has been sufficiently basic in order that the fundamental mechanism involved could be discussed. The general objective of the research program therefore is to secure more basic information on the mechanism of the rolling process and the influence of the different variables involved. During the present fiscal year the funds granted by the Engineering Foundation have been devoted to the research on rolling of metals being undertaken at the Massachusetts Institute of Technology.

Progress: From the progress report submitted by the chairman it is evident that work on this project did not get under way for some months after the beginning of the present fiscal year. C. W. MacGregor, who is acting as technical director of the project, has, however, engaged an assistant, and the work of fabricating experimental equipment is under way. Funds have been received from industry to supplement the grant of the Foundation. No experimental results can be expected for some time.

The project, "Investigaton on Stress-Strain Relations in Various Drawing Processes," directed by George Sachs, Case School of Applied Science, received previous support from the Engineering Foundation. Due to the war the preparation of a number of reports on the work performed under this project has been delayed but the following three will shortly become available:

(1) A report on "Experimentation on Tube Drawing with a Moving Mandrel," by G. Sachs and G. Espey, shows agreement between test data on soft brass, hard brass, and soft steel, and analysis, yielding some values of friction coefficients.

(2) A report on "The Flow of Metals Through Tools of Circular Contour," by G. Sachs and L. J. Klingler, contains an analysis of the stresses encountered in the numerous forming processes in which all possible combinations of driven rolls, undriven rolls, radiused dies, and straight mandrels are used as tools.

(3) A report on "Effect of Spacing Between Dies in the Tandem-Drawing of Tubular Parts," by G. Sachs and G. Espey, presents data on the reductions possible in two draws performed in series on tubular-steel drawpieces, for various distances between the two dies, various combinations of the two reductions, and two different ratios of wall thickness and tube diameter.

The project, "Investigation on Friction at Extreme Pressures and at High Temperatures," at the Westinghouse Research Laboratory and under the supervision of the chairman of the Committee, received previous support from the Foundation. During the present fiscal year work under this specific project has been interrupted because of inability to assign a research engineer to the project.

Rolling Friction, Project 89.

This study is being conducted at Massachusetts Institute of Technology under the auspices of the A.S.M.E. Research Committee.

Objective: The proposed investigation coupled two lines of attack. First, a critical review of the literature both experimental and theoretical; and second, the compilation of data from rolling-friction experiments on mine-car wheels conducted by M. D. Hersey and his assistants in the U. S. Bureau of Mines. The study aimed to construct a general picture of the physical loss in rolling resistance, pointing out some of the directions in which future research may be needed.

Progress: This study, which has been undertaken by M. D. Hersey at Massachusetts Institute of Technology, has proceeded along the lines set forth in the objectives already mentioned. The study is not yet completed but the results so far obtained may be stated as follows:

(1) The present handbook and textbook data hardly seem adequate for future applications. The values given for the moment arm, or so-called "coefficient of rolling friction" for various materials, are often assumed constant for want of information concerning test conditions. Little attempt has been made to express the physical laws governing rolling resistance. Even the research literature is inconsistent and confusing, though there have been a few brilliant contributions. A first draft of the bibliography numbers 91 titles, of which 28 have been tentatively classified as containing original experimental data on rolling resistance. Other titles deal with the friction of ball and roller bearings, and with theoretical investigations.

For comparative study the published data are being plotted on charts showing the rolling-friction ratio as ordinate against the wheel or roller diameter as abscissa. The friction ratio is the quotient of the force applied at the axis to overcome rolling resistance, divided by the load. It is equal to the ratio of moment arm to radius, the moment arm being the distance from the line of action of the load to that of the resultant supporting force. The reported values range from 0.28 per thousand (i.e., 0.28 lb pull per thousand lb of load), for the static resistance of six-inch diameter polished cast-iron rollers up to about 160 per thousand (20 in. pounds per ton in.) for the kinetic resistance of 48-in. diameter tractor tires on dry sand. This corresponds to a variation in the moment arm from about 1.7 mils or thousandths of an inch up to 3.8 inches, a range of more than 2000 to 1, though it is suspected that some of the higher values include other losses than rolling friction.

(2) The computations in progress aim at determining rolling-friction values from the tests on mine-car wheels previously conducted by Mr. Hersey and his associates at the Bureau of Mines Experiment Station in Pittsburgh, Pa. It is hoped that a sufficient range of variables was included to make these results useful in arriving at a better understanding of the laws of rolling friction. The first step is to measure numerous distances between electric-contact marks on long paper strips, or chronograph records. After plotting the measurements it is possible to evaluate the deceleration of the wheels in coasting along straight track. This deceleration is proportional to the rolling resistance. At least two thirds of the records have now been measured. The curves will require careful checking and readjustment because of the scattering of the observations, especially under the lighter loads where accidental disturbances are comparable with the effect of rolling friction. The test method used was an original one, limited to moderate speeds, by which heavy loads can be applied to large wheels without introducing bearing friction.

From the foregoing experiments it appears that kinetic rolling friction is less than static at low speeds, but that it increases with increasing speeds in a manner suggesting plastic deformation. Static rolling friction increased with the time elapsed while standing still. Kinetic rolling friction seems to be slightly greater at the beginning of a run. Rolling friction decreases with increasing hardness, but increases with surface roughness. Paradoxically, the moment arm decreases slightly with increasing loads; and it is roughly proportional to the square root of the diameter.

In a representative series of tests under a load of 2000 lb per wheel on 18-in. diam. cast-iron wheels with machined treads, rolling at 5 miles per hour on steel rails laid in concrete, the friction ratio was found to lie between 2 and 3 per thousand (or from 4 to 6 lb per ton). The same value was found under static conditions. This is from one quarter to one half the total drawbar pull reported for mine cars fitted with various types of bearings and traveling on clean level track at constant speed. Rolling friction between wheel tread and top of rail is therefore a relatively small but not an unimportant force. The resistance in the foregoing tests dropped to a minimum at some very low speed not observed, and increased continuously at higher speeds. The corresponding moment arm at zero and 5 miles per hour is between 20 and 30 mils (0.020 to 0.030 inch), with higher values for higher speeds and larger wheel diameters.

Strength of Metals, (Mechanical Springs), Project 85.

Chairman, J. R. Townsend, apparatus materials engineer, Bell Telephone Laboratories, Inc., New York, N. Y.

This particular project, to which the Foundation contributed in 1944–1945 partial support, covered completion of a book on Strength of Metals by D. J. McAdam, Jr., and R. W. Clyne of the Bureau of Standards. It is reported that the manuscript which has been in preparation for a number of years is now practically completed and it is expected that arrangements for publication can be made in the near future.

Fluid Dynamic Problems in the Design and Operation of Turbines and Compressors, Project 86.

Under direction of A.S.M.E. Research Committee, J. F. Downie Smith, engineering department, research division, United Shoe Machinery Corporation, Beverly, Mass.

Objective: Support of this project was requested in 1944 by the A.S.M.E. Research Committee to assist Dr. John R. Weske, professor of aerodynamics, Case School of Applied Sciences, Cleveland, Ohio, in the preparation of a book or monograph covering fluid dynamics as applied to turbines and compressors. In compliance with this request the Foundation made a small grant for the year 1944–1945.

Progress: During the war years Dr. Weske was unable to continue energetically on the project but since V-J Day he has been able to make progress steadily. The proposed book was to treat eight general topics and it appears that the following chapters have been completed: (Dr. Weske having in the meantime transferred his activities to Rensselaer Polytechnic Institute and later to Purdue University where he is now located.) Basic Relations of Fluid Dynamics; Fluid Filament Theory; Two-Dimensional Theory of Blade Grids; Three-Dimensional Aspects of Flow Through Blade Rows; Characteristics of Turbine and Compressor Stages; and Flow Through Blade Rows With Losses.

Dr. Weske indicates that the project at this time is approximately 40 per cent completed.

New Army Program to Train 400 Officers Annually

THE new War Department program of sending 400 officers annually to higher educational institutions for advanced studies has created new opportunities for young engineers and scientists.

The program, opened to officers of the Army Ground Forces under 30 years of age or those under 35 who show exceptional qualifications, is predominantly one of technical studies. has These include atomic energy, electronics, nuclear physics, and aerodynamics.

To be eligible an officer must be commissioned in the Regular Army, be a candidate for such a commission, or be enrolled in a civilian component, and pledge to serve four years on active duty after completing his studies.

Graduate Fellowship in Gaseous Fuels Offered

A graduate fellowship in gaseous fuels has been established at the Case School of Applied Science by the Bryant Heater Company, Cleveland, Ohio.

The fellowship is open to all graduates in mechanical engineering and carries a stipend of $1850, of which $500 is in form of tuition.

Further information on graduate requirements and application forms may be obtained by writing to the Dean of the Graduate Division, Case School of Applied Science, Cleveland 6, Ohio. Applications should be filed by April 1.

A.P.I. Speakers Deny Decline in U. S. Oil Reserves

SPEAKERS at the twenty-sixth annual meeting of the American Petroleum Institute, held at Hotel Stevens, Chicago, Ill., Nov. 11 to 14, 1946, sought to dispel reports that this nation was faced with dangerously declining liquid-fuel reserves.

Eugene Holman, president, Standard Oil Company of New Jersey, and Ralph T. Zook, president, Sloan and Zook Company, Bradford, Pa., were among those who addressed the meeting.

Mr. Holman said that apart from the known oil reserves, considerable progress had been made in reducing the cost of liquid fuels produced from gas, coal, and oil shale. On the basis of actual pilot-plant demonstrations, he declared, an automobile owner would fuel his car with gasoline made from coal at an average additional cost over gasoline of not more than 10 cents a day.

Mr. Zook declared that "tremendous quantities of underground oil, over present proved reserve of more than 20 billion barrels, will be recovered through the development of advanced secondary-recovery methods." He urged the industry to increase its expenditures for secondary-recovery developments.

Captured Diesel Engines Exhibited by Navy

ENGINEERS who want to feel that the war is over and that technical information has finally lost the aura of "hush-hush" are urged to see U. S. Navy's exhibition of captured enemy Diesel and gasoline engines at the U. S. Naval Engineering Experiment Station, Annapolis, Md.

They will need no birth certificate, no photograph, no pass-card, no appointment, in fact all that is required at the gate is the simple expression, "I want to see the Captured Enemy Equipment Exhibition."

Besides Diesel and gasoline engines, the exhibition contains many designs of enemy pumps, blowers, turbines, free-piston compressors, and many other specimens of mechanical equipment. The specimens are arranged for the convenience of the visitor. Many are disassembled and the parts are laid out for easy inspection and study. Others are sectioned to reveal internal design.

Visitors are encouraged to make sketches, take notes, and study operating-instruction books pertaining to the exhibited machinery. Naval personnel are available to conserve visitors' time and even to disassemble an exhibit to obtain information required.

Among the engines to be seen are the following: Daimler-Benz Diesel engine, model MB-501C, 20-cylinder, "V" type, 4-cycle; M.A.N. Diesel engine, model MV40/46, 6-cylinder, 4-cycle; the Mitsubishi model ZC707 Diesel, 20-cylinder, "V" type, air-cooled, 4-cycle and Japanese Diesel, type 100 tank engine, 12-cylinder, "V" type air-cooled 4-cycle.

Twenty-Third Annual Meeting of the Woman's Auxiliary of the A.S.M.E.

Mrs. J. Noble Landis Re-Elected President for 1947

REGISTRATION in the women's headquarters at the Pennsylvania Hotel began with a rush at half past eight, Monday, Dec. 2. By noon that day one hundred and ninety-eight women had received badges from Mrs. H. E. Erb, chairman of registration. This number was subsequently raised to three hundred at the end of the Annual Meeting.

Many of these early comers attended the Keynote Luncheon, reporting back to headquarters an excellent meal, an inspiring address, and a very good time. The big event on Monday was the Tea Dance most ably planned and carried out by the co-chairmen, Mrs. C. H. Young and Mrs. F. M. Farmer with the assistance of Mrs. Crosby Field and her "asKme" girls. The honor guests took turns pouring, beginning with Mrs. Yarnall and Mrs. O'Brien at opposite ends of the tea table. The Auxiliary owes a debt of gratitude to the Society for this enjoyable annual event.

Tuesday's program, a chartered bus trip to United Nations Headquarters with luncheon en route in the Sky Line Terrace at La Guardia Air Field proved so popular that a second bus was needed and, had it been possible to secure more tickets at Lake Success, a third would have been filled. The trip was conducted by Mrs. E. B. Smith, Mrs. R. B. Purdy, and Mrs. J. M. Labberton as hostesses. Again, we are indebted to the men for their contribution toward payment of the bus hire. The women who did not go in the buses organized luncheons with Mrs. H. T. Kessler, chairman of hostesses in charge. Some of them watched the skating from a window table in the French Restaurant at Radio City.

Wednesday morning Mrs. J. N. Landis, national president, A.S.M.E. Woman's Auxiliary, called the Annual Business Meeting to order. Mrs. F. W. Gibson, chairman, Student Loan Fund, reported a total of $8216.86 in the Fund, including four outstanding loans. Mrs. W. E. Karg, chairman, Calvin W. Rice Memorial Scholarship Fund, reported a balance of $377.68 in the Fund Sept. 3, 1946. This is exclusive of $500 given to a South American student at Purdue University this year.

The section chairmen present were: Mrs. A. B. Openshaw, Chicago; Mrs. C. M. Hickox, Cleveland; Mrs. G. F. Keene, Philadelphia; Mrs. G. W. Nigh, Metropolitan. Mrs. C. Robertson of Los Angeles could not be present but sent as her representative Mrs. R. G. Roshong. The chairmen told of their Section's activities during the past year, plans for the year ahead, and gave the treasurer's report. The Auxiliary president expressed her gratitude to the officers and the council members of the Society for the recognition and appreciation given the organization during the past year.

The president announced the moving of Mrs. A. W. Anderson, the assistant treasurer, to California where she will be an ardent worker in the Los Angeles Section.

The name of Mrs. Charles Gus, national treasurer for several years and long a faithful member, was placed in memoriam.

After Section reports, Mrs. A. R. Cullimore, chairman of elections, announced the officers chosen to serve on the National Board for 1947. They are:

President, Mrs. J. N. Landis; first vice-president, Mrs. J. J. McCarthy; second vice-president, Mrs. E. B. Smith; third vice-president, Mrs. V. M. Frost; fourth vice-president, Mrs. P. M. King; fifth vice-president, Mrs. F. M. Farmer; recording secretary, Mrs. C.

AT THE A.S.M.E. WOMAN'S AUXILIARY HEADQUARTERS

(*Left to right:* Mrs. G. H. Nigh, chairman, Metropolitan Section; Mrs. A. B. Openshaw, chairman, Chicago Section; and Mrs. B. F. Keene, chairman, Philadelphia Section.)

Gladden; corresponding secretary, Mrs. F. W. Miller; and treasurer, Mrs. R. B. Purdy.

Mrs. Landis, who was re-elected president, then introduced D. Robert Yarnall who spoke briefly in appreciation of the women and their work as he has seen them in action at the Section meetings and in the many cities he has visited during his term as president of The American Society of Mechanical Engineers. Mrs. Eugene W. O'Brien and Mrs. Yarnall were then introduced and greeted the members. The Auxiliary has learned to know and love Mrs. Yarnall and looks forward to many pleasant and enjoyable occasions with Mrs. O'Brien as First Lady.

After adjournment the Annual Luncheon was held at the Washington Square Club House of the Engineering Woman's Club. Seated on Mrs. Landis' right was Mrs. Yarnall, on her left Mrs. O'Brien. Other guests of honor were Mrs. W. A. Carter, Mrs. R. F. Gagg, Mrs. R. M. Gates, Mrs. C. M. Hickox, Mrs. E. J. Kates, Mrs. B. F. Keene, Mrs. A. J. Kerr, Mrs. T. S. McEwan, Mrs. A. B. Openshaw, and Mrs. E. E. Williams. Mrs. Nigh introduced the guests to the eighty-five women present and presented corsages to Mrs. Yarnall and Mrs. O'Brien. The flowers decorating the tables, a gift from Mrs. Gates, were arranged by Mrs. C. B. LePage assisted by Mrs. Young, Mrs. Farmer, and Mrs. Bliss. After luncheon, there was bridge and sightseeing, the latter with Mrs. Gagg as escort.

The Banquet and Honors Night on Wednesday was a big affair where the women, from the side lines, applauded the achievements of their menfolk but shared with them the pleasures of an excellent meal and excellent dance music.

Thursday was taken up by a behind-the-scenes tour of the N. B. C. Studio at Radio City, luncheons, and a theater party. In the television studio one of our guests to go on the air was Miss S. M. Dushkes who on Monday evening had presented a paper before the Society. Mrs. B. Zenaty and Mrs. C. F. Kayan were in charge of this tour, and in the afternoon Mrs. Kessler took a group to the Museum of Natural History while Mrs. Tiff accompanied the theater party to see "O Mistress Mine."

MRS. B. F. KEENE POURS TEA AT THE TEA DANCE, MONDAY AFTERNOON

Friday was given over to shopping and sight-seeing, including a visit to the Cloisters in Fort Tryon Park. MRS. G. W. NIGH, chairman, Metropolitan Section.

Annual Student Luncheon Addressed by President Yarnall and President-Elect O'Brien

Awards Presented to V. S. Rykwalder and P. A. Thompson

THE annual student luncheon was held on Wednesday, Dec. 4, in the ballroom of the Pennsylvania Hotel, during the Annual Meeting of the A.S.M.E. The members joined with the students in making the luncheon a combined member and student affair.

After luncheon had been served, Alton C. Chick, toastmaster, and vice-president, A.S.M.E., introduced those at the speakers' table. They were Henry Ballou, Paul A. Thompson, winner of undergraduate student award, Victor S. Rykwalder, winner of Charles T. Main award, R. P. Reece, chairman, Committee on Relations With Colleges, Martin Goland, winner of junior award, D. R. Yarnall, president A.S.M.E., Eugene W. O'Brien, president-elect, A.S.M.E., F. D. Herbert, fellow A.S.M.E., representing the "Old Guard" members, L. Austin Wright, member A.S.M.E., general secretary, Engineering Institute of Canada, and C. E. Davies, secretary, A.S.M.E.

Mr. Chick asked Mr. Herbert to speak a few words to the students. Mr. Herbert said that the Old Guard had decided to increase the funds appropriated to the student members, and hoped to bring the appropriation up to $2000 in prizes so that more students could attend the Annual Meeting; plans to that end are being worked out by the Society, he said, and would be given to the Old Guard when ready.

AWARDS PRESENTED

Mr. Chick next called on Mr. Reece, chairman, Relations With Colleges, to read the citations for the two awards. Mr. Reece read the citation for the Charles T. Main award, established in 1919, for the best paper within the general subject of the influence of the profession upon public life, and President Yarnall presented to Victor S. Rykwalder, the winner, the certificate and check, for his paper, "Creative Engineering as a Factor in Promoting Full Employment." Mr. Rykwalder received his training in the University of Detroit in 1939, but gave only part time to his college work during the war, while working for the Lee Engineering Company of Detroit, where he was advanced from a machine designer to the position of assistant chief draftsman in 1944 and 1945. He then devoted full time to his studies, securing his degree in 1946. He was elected chairman of the student branch of the A.S.M.E. at the university during his senior year. He is at present employed by the Wyandotte Chemicals Corporation of Wyandotte, Mich., as a mechanical engineer, engaged in steam-power study. Next, Mr. Reece read the citation for the undergraduate student award, established in 1914, and presented for the best paper or thesis submitted by a student member. President Yarnall presented the certificate and check for this award to Paul A. Thompson for his paper, "Synthetic Sapphire—A New Industrial Engineering Material." Mr. Thompson, a junior at the Illinois Institute of Technology, is enrolled in the mechanical-engineering curriculum and is taking studies in the management option. He is business manager of *Technology News*, the student paper. He has been a member of the A.S.M.E. student branch at the Institute for one year, and was its representative at the Midwest Group Student Meeting held at the University of Notre Dame in April, 1946. For three years prior to his enrollment at the Institute he worked in the Sapphire Products Division of the Elgin National Watch Company, the last year in its research department. He was also employed in the tool-design department of the Ford Motor Company at the Willow Run plant at Ypsilanti, Mich., for one year.

PRESIDENT YARNALL ADDRESSES STUDENTS

Mr. Chick then asked President Yarnall to deliver his message to the students and members. President Yarnall said that before he gave his brief message he would like Ernest Hartford to step up to the dais, as he wanted to take the opportunity at the Annual Meeting this year, to call special attention to the long and devoted service for the Society of this outstanding executive secretary, Ernest Hartford. "If my mathematics are correct," said President Yarnall, "Ernest Hartford came with the Society in 1911. The Council recognizes 25 years of service; Ernest Hartford has already had that recognition; five years later he had his 30-year recogn tion, and this year the Council passed a resolution honoring Ernest Hartford for thirty-five years' devoted service." After the audience had greeted Mr. Hartford with a hearty round of applause, President Yarnall then spoke on "Unionism and Collective Bargaining and Our Society's Responsibility." The text of President Yarnall's alk will be found on pages 80–81 of this issue.

PRESIDENT-ELECT O'BRIEN INTRODUCED

The next speaker introduced by Mr. Chick was Eugene W. O'Brien, president-elect, A.S.M.E. Mr. Chick said that Mr. O'Brien was an old friend of his of thirty-five years' standing, a man who has served the Society in many phases of its work, on many of its committees, and on the Committee on Relations With Colleges; he had also served on the Com-

mittee on Relations With Colleges of the A.I.E.E., and as manager and vice-president of A.S.M.E.

Mr. O'Brien said that this meeting was a joint meeting of the student members and the older members, and that the student members were in part guests of the older members. He felt that he would like to continue briefly the theme of President Yarnall's, just as he would like to continue the sort of administration which President Yarnall had given in the past year. There were two programs of special interest to him, he continued, and to illustrate, he told the story of Al Smith, who, when he came back from Albany, after his defeat as the minority leader of the Democratic party, brought with him a gold watch which had been presented to him by his workers there. When he showed it to one of his old ward leaders in New York, the man said, "Did they all chip in and give you that beautiful gold watch, Al?" "Yes, Terry," said Al, "there were 104 of them and 103 chipped in." "That's the trouble with the Irish, Al," said the old ward leader, "they just won't standtogether." "That," said Mr. O'Brien, "is the state of the engineers; they take different roads and cannot get individuals to agree. Mr. Yarnall has mentioned the E. J. C. Council. I meet with it tomorrow as a representative of your Society. I meet with it for the first time, and I hope to study its problems for the next two years. I hope we shall get certain things done. I think we can take some steps, even if a little wrong, but in general in the right direction. Become a part of this engineering council, get together, and go into any society you choose after graduation, regardless of what student branch you belong to as a student. This is a primary objective of the engineering profession and a most important objective. It is of prime importance to student engineers, and an important factor in their future.

"Second," continued, Mr. O'Brien, "I will illustrate this point too by a story. An old contractor friend of mine who had led a life of the sins of pleasure but not sins of meanness, was well liked. Finding he had a cancer and had only a few months to live, he went to a priest and was forgiven. When he died all his friends came to the funeral. The priest, very wisely, for five minutes justified the charity of the Church in forgiving the man but justified the justice of the Church by condemning him to spend a little time in purgatory. An old contractor friend in the back row, on hearing this, was heard to remark, 'You know that purgatory is a grand idea; we all know that Bill would feel like hell in heaven.'"

"A young engineer just out of college goes through purgatory or limbo in his profession. In engineering, in operation, and in management, conditions are quite different from those experienced in acquiring an education. Viewpoints are quite different from that of the student or professor. Part of this purgatory can be by-passed by maintaining a continuous and progressive contact between student branches and local sections. A student gets acquainted with engineers in his own locality. He acquires a knowledge from association with members of his own profession. He gets experience in joint activities. He learns the difficulties of getting things done from a to z. He learns how successful engineers operate; the executive quality that he does not get in technical schools. Loud talk and careless dress are not an indication of a virile engineer but merely an admission of weakness. How will you express what you know? Knowledge doesn't mean a thing unless you are able to express and impart. Learn to speak before large groups and across the table in casual conversation. It is, too, a question of whom you know. That is one of the major objectives of a meeting of this sort. The ability to express what you know is dependent upon whom you know. Cultivate the older members in your profession and those students known to you. Pick your associates carefully. Our hope is that through such meetings as this you will be able to increase your effectiveness and increase your opportunities. Take advantage of possibilities offered you. That engineer succeeds most and serves best who combines with technical knowledge an ability to get along with people."

At the close of Mr. O'Brien's talk, Mr. Chick introduced Martin Goland, a junior, who had just won the junior award of the Society. Mr. Goland gave a summary of his prize-winning paper, "The Flutter of a Uniform Cantilever Wing," and then showed an Army training-station film illustrating the causes and prevention of "flutter."

Sections

Metropolitan Section Discusses Economic and Professional Status of the Engineer

Yarnall and Ransom Speak

THE ideal of professional service was defined by D. Robert Yarnall, past-president A.S.M.E., in the words of Vannever Bush, wartime director, Office of Research and Development, as "simple ministration to the people." He spoke before 300 engineers and guests of the A.S.M.E. Metropolitan Section who gathered in the Engineering Societies Building, New York, N. Y., on Nov. 8, 1946, to discuss the question, "Organization of the Engineering Profession—Should Engineers Join Unions?"

On the same program C. W. Ransom, chairman, National Societies Committee, General Electric Engineers Association, called "collective co-operation" the ideal relationship between top management and the organized professional engineers employed by large corporations. Mr. Ransom's committee prepared the report, "An Immediate Measure to Strengthen the Professional and Economic Position of the Engineering Profession," which was published in the September, 1946, issue of MECHANICAL ENGINEERING.

The two speakers were followed by many others who came to the meeting charged with feeling and the desire to express how they felt about unionization.

Two well-defined concepts came out of the discussions: One, of top management, aware of its opportunity to foster the professional aspirations of young engineers and eager to take positive action as soon as facts on the economic status of the engineers have been developed; the other, of the dilemma of the young engineer, torn between his ideal of professional loyalty and service to his employer and his aspiration for economic betterment aroused by the recent advances of the nonprofessional man.

Referring to his own organization which employs 500 men and many engineers, Mr. Yarnall said that he had a sense of personal guilt with regard to management's past attitude toward the aspirations of young engineers. Mr. Yarnall spoke of his own personal aspirations and beliefs in the engineering profession and said that he found among them more than the need and desire for making money. He described the engineer as a man recognizing many responsibilities, as one who believes in natural laws, has faith in the truth of integrity of men, one who strives for an environment of social betterment, and assigns to the machine the function of alleviating human toil.

With the unions doubling their efforts to force engineers into collective-bargaining units, Mr. Yarnall said that the engineering profession can no longer sidestep its responsibility in this controversial field. He said that the A.S.M.E. has been inhibited by legal advice from taking formal action, but that the Society has taken definite action through the E.J.C. Committee on the Economic Status of the Engineer. This committee is completing three important surveys which will supply facts as a basis for action by engineers and top management alike. These surveys are: (1) A survey of the report of earnings of 85,000 engineers, with relation to education, years of practice, and field of specialization; this report will be completed in June, 1947; (2) survey of 2000 industrial companies to determine company policies pertaining to selection, training, placement, guidance, and professional activities of graduate-engineer employees; (3) survey of the problem of collective bargaining as it affects or may affect engineers in professional work and in training.

Mr. Ransom, who followed Mr. Yarnall, said that graduate engineers in industry have been able to maintain their pride and loyalty to the ideals of the engineering profession despite the emotional battering these ideals sustain by the successes of the unions. He said that two factors were responsible for the "conflict, confusion, and hopelessness" that exist among the younger engineers in industry. These are loss of economic status caused by the relative rise of the nonprofessional man and the loss of professional status caused by the unions' attempt to class engineers in an undifferentiated mass of salaried employees.

While engineers had formerly looked to the Founder Societies for leadership and guidance, they have "lost faith in top-flight planning," Mr. Ransom said. They have relied on their own initiative and have organized associations of professional employees. Currently, engineers have consolidated widely scattered associations into a national association. Mr. Ransom also spoke of the National Society of Professional Engineers but said that the leadership needed to protect the engineer from the union now lies in the Founder Societies and that some way should be found to unite the work of the associations and the N.S.P.E. with the machinery of the Founder Societies.

In the discussion period that followed, George G. Hyde, member A.S.M.E., consulting engineer, New York, N. Y., succinctly laid responsibility for the relatively poor economic condition of the engineer at the door of management. He was uproariously applauded.

Adolph Ehbrecht, member A.S.M.E., vice-president, Gries Reproducer Corporation, said that management has no guide to direct them in establishing payment of engineers with relation to nonprofessional employees.

Many other speakers had an opportunity to express their views on the question.

"Structural Plastics" at Akron-Canton Section

On Nov. 14 at the Y.W.C.A., Akron, Ohio, a talk entitled "Structural Plastics for Mechanical Parts," was given by George K. Hammond of Owens-Corning Fibreglas Corporation. Mr. Hammond told of recent developments in the manufacture and application of plastics for use in mechanical parts, and of problems to be met by the engineer in the design of such parts. Twenty-eight were present.

Anthracite-Lehigh Valley Section Hears Talk on Oxygen

On Oct. 25 at the Hotel Americus, Allentown, Pa., Frank E. Pavlis, technical director, Air Products, Inc., gave a talk entitled "Oxygen as an Industrial Tool." After tracing the history of oxygen from its early use in industry, Mr. Pavlis explained the new uses to which oxygen on a low-cost basis can be put in oil, steel, coal, and chemical industries, through enrichment of atmosphere for combustion and in the making of various products. He then gave a very complete description of the apparatus required. The audience numbered 60.

W. J. King Speaks at Baltimore Section

The first meeting of the season was held at the Engineers Club, Baltimore, Md., Oct. 28, and was attended by 90 members and guests. After dinner, Prof. W. Julian King, director of the Sibley School of Mechanical Engineering, Cornell University, spoke on "Personal and Professional Problems of Engineers." Professor King explained that his keen interest in the subject had sprung from experience as a liaison officer between a group of engineers and the management of a large industrial concern over a number of years. He said that today both management and engineering employees are vitally interested in "human engineering," and it is evident on the part of management that the practice of twenty to thirty years ago of hiring an engineer and allowing him to adapt himself as best he could to the job has been outmoded. The employer attempts to indoctrinate the employee in the phases of his work and is concerned with his psychological well being, or morale, and sets up criteria for promotion, thus clarifying one of the most important questions of the employee. The employer expects certain things for the wage he pays the engineer, and the employee has ideas which the employer should consider.

The engineering employee expects vigorous leadership. This does not imply paternalism or a laissez-faire attitude, but a good idea of the direction of the company's interest.

The speaker pointed out that today technical improvements by engineers effect savings for their companies but that labor is quick to grab these savings, leaving the problem of how the engineer may obtain some additional remuneration for his efficiency. Professor King said that it may well be that the engineer could be high-pressured into collective bargaining, although he is more interested in collective co-operation and freedom of deliberation. He said, in closing, that recently, after long silence on the part of employers in any matters of collective interest to them and their employees, it has become evident that such voice is constitutional. Messrs. Woodward, Whitman, Roy, Penniman, Hyde, and others led a very interesting discussion of Professor King's talk.

On Nov. 25 Ralph P. Johnson, chief engineer, Baldwin Locomotive Works, spoke to 150 members and guests, on recent developments in the modern steam locomotive and what is ahead in railroad motive power. He touched upon all types of railroad locomotion, including the ordinary fire-tube-boiler type, the newer steam-turbine locomotive, Diesels, electrics, and the projected gas-turbine locomotive. It was Mr. Johnson's opinion that all of these types have their place in modern railroading and the choice of the proper type is a matter of economics. Not much will be gained in thermal efficiency in the ordinary steam locomotive, but better performance will result from going to welded boilers, higher pressures, and higher temperatures. This, however, may entail certain design changes not hitherto experimented with.

Boston Section Hears Prof. F. K. Morris

On Nov. 21 at the Massachusetts Institute of Technology, Cambridge, Mass., Prof. Frederick K. Morris spoke on "Germany—the World's Problem." Professor Morris showed that Germany's problem was a threefold need: (1) homelands, (2) foodlands, (3) resource lands. He explained that Germany's solution was through world domination, and her three last wars were directed to that end. He showed how the peace treaty of World War I failed to give a solution of this problem; how, in fact, it aggravated the problem by greater consolidation of the people, and subtraction of her resources. The speaker contended that the only solution is a peaceful expansion of German peoples into other lands. Seventy-five were in the audience.

Accountant Heard at Central Indiana Section

On Nov. 15 in the Athenaeum Blue Room, Indianapolis, Ind., Charlton N. Carter, certified public accountant, spoke on "The Industrial Engineer and Cost Accountant." Mr. Carter, using his experiences over the last 25 years, explained the functions and duties of the industrial engineer and the cost accountant and their relationship to each other. Twenty members and five visitors were present.

Central Iowa Section Inspects Publishing Plant

A dinner meeting ushered in a new season for the Section. After dinner in the Meredith Publishing Company's cafeteria, Des Moines Iowa, and following a short business meeting, Glen Boylan, vice-president and director of manufacturing, Meredith Publishing Company, spoke on "Creative Imagination and Creative Thinking." He told the audience that their success is probably being determined by the quality of creative imagination and creative thinking which they apply to their problems. He described methods that may be used to develop creative imagination and outlined a technique for applying creative thinking to a specific problem. The points were illustrated by examples of achievements by men who have applied creative imagination and creative thinking to problems in the printing, publishing, and other industries. The members then made an inspection of the Meredith printing plant which has the largest pressroom west of the Mississippi River, and is equipped with the latest color presses. Sixty members and 9 guests were present.

Chicago Section Joint Sponsor at Hydraulic Machinery Conference

On Oct. 22 the Heat Transfer and Fluid Flow Division of the Section was joint sponsor with the National Hydraulic Machinery Conference at a dinner meeting at the Hotel Continental, Chicago, Ill. Dr. Hunter Rouse, director of the Iowa Institute of Hydraulic

Research, State University of Iowa, gave a paper entitled "Similarity in Fluid Motion." Dr. Rouse showed some very interesting motion pictures illustrating his lecture. His exposition showed the interesting possibilities of applying fundamental principles of fluid motion to widely different professional fields such as aerodynamics, ventilation, steam and water turbines, and many other fields. Members and guests totaled 150.

Martin Frisch Speaks at Cincinnati Section

On Nov. 7 at Engineering Society headquarters, Cincinnati, Ohio, a dinner meeting was held, at which the speaker was Martin Frisch, member A.S.M.E., director, engineering and development, Foster Wheeler Corporation, New York, N. Y. His subject was "Some Problems in the Generation of Pure Steam at High Pressures." The speaker showed slides which tabulated a great deal of research done by him and his company on the interrelation of water conditions and boiler-drum design, of steam scrubbers and driers, and of boiler-circulation systems, including "dual circulation" designs—all as affecting the production of the purer and purer steam demanded by the higher-pressure installations, particularly those requiring large percentages of make-up, where turbine-blading deposits are extra critical problems. Forty-three members and guests attended the didner and nearly a hundred heard the talk.

Factory Management Subject at Cleveland Section

On Nov. 14 at the Cleveland Engineering Society, Cleveland, Ohio, Dr. Georg C. Schlesinger, member, A.S.M.E., consultant, spoke to an audience of 125 on "Problems of Factory Management." This talk covered the fundamental cost-accounting principles of any manufacturing plant and the need for close supervision to insure profits.

"Sidelights of Mathematics" Talk at Colorado Section

On Nov. 8 at the Oxford Hotel, Denver, Colo., Prof. C. A. Hutchinson of the University of Colorado, spoke on "Sidelights of Mathematics." He gave a brief outline of the engineering-mathematics department's viewpoint, distinguished from pure mathematics at the University. Professor Hutchinson also discussed the vibration problems, illustrated by a model; complicated surfaces which involve complicated mathematics, illustrated by simple models and soap films; and described and illustrated the various paradoxes. Thirty-three were in the audience.

Steam-Boiler Design Subject at Erie Section

The regular monthly meeting was held on Nov. 14 at the General Electric Community Center. A dinner attended by 75 members and guests opened the meeting. E. G. Bailey, fellow A.S.M.E., vice-president, Babcock and Wilcox Company, and president of the Bailey Meter Company, was the principal speaker. He spoke on "Trends in Steam-Boiler Design," reviewing briefly boiler development since the days of the Lancashire and Cornish boilers, and telling of progress in the last decade. His talk was illustrated with slides. "The most efficient utilization of fuel," he said, "is of the utmost importance in the field of power generation, regardless of whether power generation is accomplished by means of steam turbines, gas turbines, or atomic energy." He stressed the need of broader education for power engineers rather than specialization in a narrow field.

Fairfield County Section Hears Westport, Conn., Industrialist

On Nov. 21 at the Barnum Hotel, Bridgeport, Conn., 50 members and 55 guests heard Miss Vivien Kellems, Westport, Conn., industrialist, speak on decentralization. Miss Kellems said that there has been a tremendous centralization of power in Washington during the past decade and she felt it is high time that the power is taken back. She believed less labor friction would be the result of decentralization of large unions and consequent increase in the powers of individual unions. Commenting on decentralization of industry, Miss Kellems said, "You have no idea of the drive, the pull to get industry out of Connecticut. This state has the best skilled labor, it has the 'know how', the finest executives, beautiful factory sites—if made available—and good living conditions." The speaker offered three recommendations to improve conditions for industry in the state. First, reduction of taxes; second, amendment of zoning laws in the state and the various communities; and third, the repeal of the curfew law which prohibits women working after 10 p.m. and before 6 a.m. She declared, "Today our economy makes it essential that a certain percentage of women work. Women must be given equal employment opportunities with men."

Hartford Section Has Dinner Meeting

On Nov. 19 at the City Club, Hartford, Conn., a dinner meeting was held by the Section. The toastmaster was Francis S. Murphy, publisher of *The Hartford Times*, and director, Connecticut Chapter National Aeronautic Association. Guests of honor were Eugene E. Wilson, member board of directors, United Aircraft Corporation, and Edward J. Hickey, commissioner of State Police and Public Safety, representing the Governor of the State of Connecticut. The speaker of the evening was William T. Piper, Sr., president, Piper Aircraft Corporation, Lock Haven, Pa., who gave an address entitled "Personal Flying, Light Planes, and Airports." Mr. Piper, who is a director of the Aeronautical Chamber of Commerce of the U. S., member of the National Aeronautics Association, and member of the National Aviation Training Association, said that the great need in aviation is more airports, readily accessible to the nation's communities. He traced the development of the private plane in the field of aviation and told of some of the difficulties he, personally, faced in getting started. When his firm first flew a small flying plane to the West Coast in 1934, people in that region who saw the size of it, had at first no interest in it. At that time they were conscious only of big Army planes and could not conceive of anything smaller as being practical. But, he added, when they saw the so-called "puddle-jumpers" actually making flights on three gallons of gasoline, they began to show interest. The high cost of flying instruction was another factor in keeping Americans from becoming privately air-minded prior to the war, continued Mr. Piper. He was optimistic about the future of privately owned planes, although he said that this part of the aircraft industry was going through the same growing pains as the automobile industry. Two hundred and fifty members and guests enjoyed the program.

E. E. Williams, A.S.M.E. Vice-President, Visits Greenville Section

The meeting on Nov. 26 of the A.S.M.E. Greenville Section featured E. E. Williams, vice-president, A.S.M.E. Region IV, who gave an interesting talk about the Society. Excellent talks were also given on "Why I am a Member of The American Society of Mechanical Engineers," by Dr. Samuel B. Earle, dean of engineering, Clemson College; John A. McPherson, The McPherson Company, professional engineers; W. Paul Tindall, Ecusta Paper Company; E. M. Williams, Pattison and Bownes Company, and Prof. J. W. Lindan, III, University of South Carolina.

Talk on Wire at Ithaca Section

On Nov. 25 at the Arlington Hotel, Binghamton, N. Y., Howard J. Godfrey, of John A. Roebling's Sons, gave a talk entitled "Wire—Its Properties and Manufacturing Processes.' Mr. Godfrey sketched the history of wire-making, stating that the first mention of wire was in the Bible in the story of the weaving of Pharaoh's robes. He described the metallurgy and manufacturing processes involved in wire-making, and illustrated with slides. Twenty-four were present.

Raleigh Section Meets with Two Student Branches

On Nov. 15 at North Carolina State College, Raleigh, N. C., a joint meeting was held with Duke University and North Carolina State College student branches. E. E. Williams, vice-president, A.S.M.E. Region IV, outlined the present activities of the A.S.M.E., together with some of the ideas for the future. George McGowan explained many of the problems involved in the research work of the American Locomotive Company, some recent developments, and told of the use of Diesel engines on foreign railroads during the war.

His talk was illustrated with slides. The audience numbered 160.

Talk on Recording Equipment at St. Joseph Valley Section

On Nov. 19 at the Spaulding Hotel, Michigan City, Ind., G. B. Bailey, member A.S.M.E., research engineer, Hays Corporation, Michigan City, Ind., spoke on the "Hays Recording Equipment." This interesting talk described new developments in combustion control and recording instruments. Illustrative slides were used to describe the various mechanical and electrical features which are considered in the development of the Hays recording equipment. Thirty members and 95 visitors were present.

Joint Dinner Meeting of St. Louis Section and A.S.T.M.

A joint dinner meeting was held with the St. Louis District of A.S.T.M. on Nov. 15 at the Park Plaza Hotel, St. Louis, Mo. The speaker was L. J. Markwardt, assistant director of the U. S. Forest Products Laboratories, Madison, Wis., who gave an illustrated lecture on "Wood as an Engineering Material." Mr. Markwardt gave historical data covering the wood industry and told an interesting story of the developments in the fabrication and use of wood during the last few years. A discussion period followed the talk. There were 63 at dinner and an additional 15 for the lecture. Among those present were: W. W. Horner, president of the American Society of Civil Engineers; A. W. Carpenter, president of the American Society for Testing Materials; and C. L. Warwick, executive secretary of the American Society for Testing Materials.

San Francisco Section Hears Two Speakers

There were two speakers at the meeting on Nov. 20 in Assembly Room 360, Mills Building, San Francisco, Calif. The first, L. H. Oppenheim of Kaiser Engineers, Inc., spoke on "Lightweight Metals Development and Application on Pacific Coast." Mr. Oppenheim traced the development of aluminum and magnesium production on the Pacific Coast and described the processes employed in refining these metals. Available production capacity has stimulated research into new applications, and old applications have been greatly expanded. He also compared their uses and costs to those of other materials of construction. The second speaker, Dean E. T. Grether, school of business administration, University of California, Berkeley, Calif., gave a talk entitled "Business Administration—Economics and the Engineer." Dean Grether observed that too frequently the engineer neglects all but the engineering aspect of a problem; his training is too valuable to permit this. He said that courses in organization and management would prepare and encourage the engineer to increase the scope of his activity. The audience totaled 65.

Southern California Section Holds Two November Meetings

On Nov. 5 in the Rodger Young Auditorium, Los Angeles, Calif., James C. Ellsworth spoke to an audience numbering 51 on "Engineering and the F.B.I." Because of the confidential nature of this talk, no details were given out for publicity.

The members visited the plant of C. F. Braun Company, Alhambra, Calif., on Nov. 14. They also heard Carl F. Braun, president and founder of the company, speak on "The Engineer and Industry." Mr. Braun said that engineers must be trained for management positions in industry; that their college training has been in fundamentals and formulas but was lacking in studies in human relationship, economics, and the proper presentation of problems to management. Members attending totaled 125 and visitors 4.

Better Business Management Topic at South Texas Section

An audience of 70 attended the meeting on Nov. 4 at the Houston Engineers Club, Houston, Texas, to hear W. V. O'Brien, manager, Central Station Division, General Electric Company, speak on "A Course in Better Business Management." The speaker explained the development of ideals and purposes of management through meeting of men on comparable positions of different departments, the threshing out of differences between individuals, exposing of problems and practices of some for the enlightenment of others, and the purpose of the ultimate establishment and indoctrination of all with better business.

Two Speakers Heard at Toledo Section

A dinner meeting was held on Nov. 26 at the Toledo Edison Club Building, Toledo, Ohio. The subject was "Modern Great Lakes Freighters," and the speakers were Prof. Louis A. Baier, professor and chairman of the department of naval architecture and marine equipment, and Charles W. Spooner, assistant professor of naval architecture and marine engineering, University of Michigan. Professor Baier told of the history in the development of the lake freighter as a bulk carrier over the past 60 years. He explained how the design of freighters was affected, not only by the type of cargoes carried but also by the depth of channels available, and the size of existing locks and dock facilities at various lake ports. He dwelt at considerable length on the proper design and installation of the propeller, and explained some of the tests recently made with a 30-ft self-propelled model of a lake freighter and the problems involved in directing the flow of water into the propeller by proper contours of the aft section of the boat to prevent such things as cavitation and inefficient propeller operation.

Professor Spooner dealt primarily with propulsion engines and their auxiliaries. A very lively question-and-answer period followed their talks. Thirty-three members and 3 members from the American Institute of Electrical Engineers, as well as guests, were present.

"Frozen Foods" Subject at Virginia Section

On Oct. 18 a joint meeting of the Section and the Central Virginia Engineers' Club was held in Ewart's Cafeteria, Richmond, Va., to hear Richard H. Catlett, president, Catlett-Johnson, Inc., speak on "Frozen Foods." He gave a splendid talk which the 81 persons assembled all enjoyed.

I. Melville Stein, Speaker at Washington Section

On Oct. 10 in the Potomac Electric Power Company's auditorium, Washington, D. C., the Section heard I. Melville Stein, vice-president, Leeds and Northrup Company, discuss "The Economic Status of the Junior Engineer." Mr. Stein is chairman of the Engineers' Joint Council Committee on the Economic Status of the Engineer. He gave a frank appraisal of the average engineer's position in the general economy on which he predicated his conclusions, and coupled it with a warning that such an appraisal must be used as the basis of any consideration of the engineer's economic status. He said that compared with other professional groups, engineers have a relatively high income level. Seventy-five members and 50 visitors were present.

Westmoreland Committee of Pittsburgh Section Organizes

The newly formed Westmoreland Committee of the Pittsburgh Section held a dinner meeting on Oct. 30 at the Mountain View Hotel near Greensburg, Pa. Arthur Moody, temporary chairman, opened the meeting with some introductory remarks on the purpose of organizing such a committee. A nominating committee was named to prepare a slate for election of the offices of chairman, vice-chairman, and secretary-treasurer. E. B. Smith was called on to say a few words about the significance of a Westmoreland engineering association. P. M. McKenna, member A.S.M.E., president of Kennametal, Inc., gave a talk on "Factors Influencing Design of Tools and Machine Elements of Cemented Hard-Carbide Composition." The talk was illustrated with slides and models. The attendance at the dinner was sixty-five and at the meeting seventy-five.

Paul G. Exline Speaker at West Virginia Section

On Nov. 25 at the Daniel Boone Hotel, Charleston, W. Va., 75 members and guests heard a lecture by Paul G. Exline, member A.S.M.E., Gulf Research and Development Company, Pittsburgh, Pa., entitled "Lubrication, Bearings, and Bearing Design." Mr. Exline reviewed in a thorough manner "oiliness," viscosity, clearance, pressure, and other fac-

tors in lubricants and bearing design. An approach to the handling of such an unfamiliar problem as lubrication by process liquids was presented by analogy with known lubricants.

Wilmington Sub-Section Hears Editor of *Power*

A dinner was held on Nov. 20 at the Hob Tea Room, Wilmington, Del., at which F. H. McBerty, chairman, presided. The speaker was P. W. Swain, editor of *Power*, who was a witness of the two Bikini atom-bomb tests last summer. In his talk Mr. Swain swept away a number of popular theories about the atom bomb which already had been exploded about the time that the bomb went off in the tests known as "Able" and "Baker." He pointed out that there had been no reason to expect either earthquakes or tidal waves. He explained that Admiral Blandy, in charge of the test, had not plotted the target array for the purpose of discovering how many ships would be sunk but had arranged the ships so that the damage could be plotted on a scale of distance from the point of explosion. Mr. Swain admitted that "the bomb is just as bad as you thought it was." To illustrate his talk, in which he said that nuclear fission was the simplest of modern technical subjects to understand, Mr. Swain exhibited films of the underwater explosion (Baker) and slides describing the atom. Ninety engineers were in the audience.

Worcester Section Hears F. T. Harrington

On Nov. 6 at the Worcester Polytechnic Institute, Worcester, Mass., F. T. Harrington of Vickers Incorporated, spoke to an audience of 80 on "Hydraulic Applications for Machine Tools." Mr. Harrington explained and illustrated with slides the hydraulic applications to drill presses, millers, grinders, gear cutters, injection molding machines, and lather. He touched briefly on their application to farm machinery and aircraft. He also showed a motion picture used by the Navy for training purposes on hydraulic transmission as applied to 40-millimeter antiaircraft guns.

Student Branches

University of Akron Branch

An informal meeting was held on Nov. 13 in the engineering laboratory, followed by an inspection trip of the power plants of the Ohio Edison Company in Cuyahoga Falls, Ohio. The trip was particularly interesting because it afforded the students a chance to see at first hand the advances made over the past two decades in steam-generating and utilizing apparatus, along with auxiliary equipment. A total of 30 made the trip.

Alabama Polytechnic Institute Branch

On Oct. 21 a meeting was held in the Ramsey Engineering Building, during which the following committees were appointed: Program committee, Shirley Cooksey, Bob Ferrell, Harold Powell, and Joe Davis; membership and publicity committee, W. E. Smith, W. G. Johnson, and Clarence Cardwell. Professor Hixon, member A.S.M.E., gave a talk on sleight of hand and hypnotics.

University of Arkansas Branch

An organizational meeting was held on Oct. 16 in the Engineering Building. Prof. R. G. Paddock, member A.S.M.E., honorary chairman, discussed the A.S.M.E., and each student was urged to join the Society. Election of officers followed: Earl J. Tullos, president; Robert Peterson, vice-president; Wm. C. Doty, secretary-treasurer.

The first official meeting was held on Oct. 30. Realizing the need of student engineers to be able to connect their studies with practical engineering, Professor Paddock had obtained an excellent film on a new and important source of power, the gas turbine. Processes, cycles, and terms used in thermodynamics were clearly shown to be of great importance in the inspection of a heat engine.

Polytechnic Institute of Brooklyn Branch

The Oct. 29 meeting was opened by Dominick Casale, chairman. He introduced the guest speaker, Charles Fay, of the Bell Aircraft Corporation. Mr. Fay spoke on "Jet Propulsion and Helicopters," and then showed moving pictures of the development of the P-59 Airacomet, which is jet-propelled, and also pictures showing the versatility of the latest Bell helicopter. A discussion period followed. One hundred and ten members and guests were present, and 21 applications for membership were received.

At the Nov. 12 meeting membership cards and A.S.M.E. magazines were distributed. Prof. George Petersen, junior member A.S.M.E., explained the importance of the A.S.M.E. Annual Meeting to be held in December. Twenty members volunteered to act as aides during the Annual Meeting. A motion picture entitled "Diesel—The Modern Power," was shown. The principle of the Diesel engine was explained, and its numerous applications were illustrated. Twenty-two applications were received, bringing the membership total to 80.

The guest speaker at the Nov. 26 meeting was Macon Fry, who gave an interesting illustrated lecture on "Computing Mechanisms" as used on various types of range finders. By means of differential gearing, cams, and various other mechanisms, it was shown how figures are added, subtracted, multiplied, and divided. Also, the introduction of several trigonometric functions into these computations were taken into consideration. Eighty-two were present.

California Institute of Technology Branch

On Oct. 14 Homer Reed, member A.S.M.E., chairman of the Los Angeles Section, and chief engineer of the Union Oil Company, spoke to an audience of 35 on "Engineering Opportunities in the Petroleum Industry." He explained the various divisions of the industry and its unlimited opportunities.

College of the City of New York Branch

On Nov. 7 in room 326, Main Building, Mr. Smith of the General Electric Company, lectured on the gas turbine. The speaker said that prior to the war what little research was done on the design of gas turbines was soon abandoned when it was found that the turbine would require materials with then unheard-of heat and strain-resisting qualities; and even if those materials could have been made available the resulting engine efficiencies would be far below what could then be realized in conventional types. The war, however, gave new impetus to the development of the gas turbine when the possibility of its use in military aircraft was introduced. Mr. Smith traced the development of the gas turbine by the Nazis, the British, and the Americans. In May, 1942, General Electric produced their first jet aircraft engine. Although the gas turbine has proved practicable in other uses, its chief use has been and continues to be in aircraft where the jet engine eliminates vibration, lowers air-resistance, where, when mass production is introduced, costs will be lower, and where the principal energy loss of the machine, the kinetic energy of the escaping gases, is utilized in obtaining the desired effect. There were 55 in the audience.

"Sintered Carbides" and their special use in machine-tool tips, was the subject at the meeting on Nov. 14. Mr. Judkins, who has long been associated with the development of sintered carbides, supervised the showing of a film, and after a short talk on the background of the metallurgical process, answered questions from the audience. The film showed in the first half the elements of the toolmaking process itself; and in the second, the correct choice and use of sintered-carbide tool tips for specific machine operation. Seventy-five attended.

The meeting on Nov. 21 in room 108, Technology Building, featured a lecture on "The Place of Higher Mathematics in Engineering Practice," by C. Dorser of the General Electric Company. Mr. Dorser pointed out that unlike the highly theoretical text problems from which we learn the principles of engineering, the situation in actual practice is one where the unknowns are many, where conditions are highly variable, but where the data are numerous. Solutions are reached by experiment, by referring to past experience, or, finally, by an analytical interpretation and analysis. It is in the analytical solution that mathematics finds its greatest use. It should be kept in mind, however, the speaker said, that mathematical analyses are only as good as the assumptions upon which they are based, and every opportunity for experimental trial

of the assumptions should be utilized. Mr. Dorser recommended that all collegiate engineering courses be made to include not only the calculus, but an engineering approach to differential equations, as well as matrix algebra, vector analysis, statistics and probability, and some dimensional analysis. The 45 members present realized, after hearing Mr. Dorser, that mathematics is the vital tool of engineering, a tool whose proper use must be mastered by all, to a degree far beyond what is now realized.

University of Colorado Branch

On Oct. 16 the meeting was called to order by Ken Marquand, chairman. After the business meeting was completed, Benjamin H. Spurlock, Jr., junior member A.S.M.E., assistant professor in the mechanical engineering department, gave a very interesting talk on the "V-2 Rocket," illustrated by slides and motion pictures.

Colorado A. & M. College Branch

On Nov. 4 members of the branch met in the Mechanical Engineering Building. After completion of current business, Prof. R. D. Barmington, member A.S.M.E., gave a talk on the process of refining sugar from sugar beets. The members then joined in an inspection trip through the local Great Western Sugar Company's plant where the different processes used in the refining of sugar and the various types of machinery used were observed in operation.

Cornell University Branch

On Nov. 13 in Sibley, Dr. Lynn A. Emerson, director of the New York State School of Labor Relations, addressed the branch on the topic "Labor and the Engineer." Summarizing the growth of labor from the formation of craft guilds to the present system of horizontal and vertical unions, Professor Emerson stressed the personal rather than the technical link that exists between the engineer and labor. W. Julian King, member A.S.M.E., director, Sibley School of Mechanical Engineering, then took the floor, to discuss the necessity of a co-operative agreement between engineers and management, as engineers are more management than labor. Eighty-five were in the audience.

University of Detroit Branch

On Oct. 8 the branch members were guests of the Detroit Section at a meeting held in the Rackham Auditorium. Hon. Edward J. Jeffries, mayor of Detroit, guest speaker, gave an interesting talk on "Problems in City Government."

The meeting on Oct. 22 in the Chemistry Building introduced the new officers. Prof. George Uicker, member A.S.M.E., honorary chairman, pointed out the aims of the Society and the many advantages that student members obtain. Robert Krause, chairman, then took over the meeting and outlined the program for the coming year. A film entitled "Turret Lathes" was shown as part of the evening's program.

On Oct. 30 the members made a tour through the United States Rubber Company's Detroit tire division. Robert Krause, chairman of the branch, is employed at this plant on the University's Co-operative System, and he was able to supplement much of what the guide described. The process of manufacturing tires was followed through the plant from the initial treatment of the cord fabric, which is made by the company at another of its plants, to the finished tire. Honorary chairman, Professor Uicker and chairman Robert Krause made the arrangements for the tour.

The meeting on Nov. 12 in the Chemistry Building arena featured Douglas Martin of the Amplex Division, Chrysler Corporation, who gave a talk on "Powder Metallurgy." Slides were shown, and hundreds of actual powdered-metal parts which the members were allowed to inspect. Among these parts were self-lubricating bearings, metal filters for liquids and gases, and many types of intricate machine parts. Mr. Martin was kept busy after his talk, answering questions concerning the many parts on display. Thirty members were present.

Duke University Branch

On Nov. 15 the branch participated in a joint meeting with the North Carolina State College branch and the A.S.M.E. Raleigh Section, on the campus of North Carolina State College. The story of this meeting is covered under the Raleigh Section.

University of Florida Branch

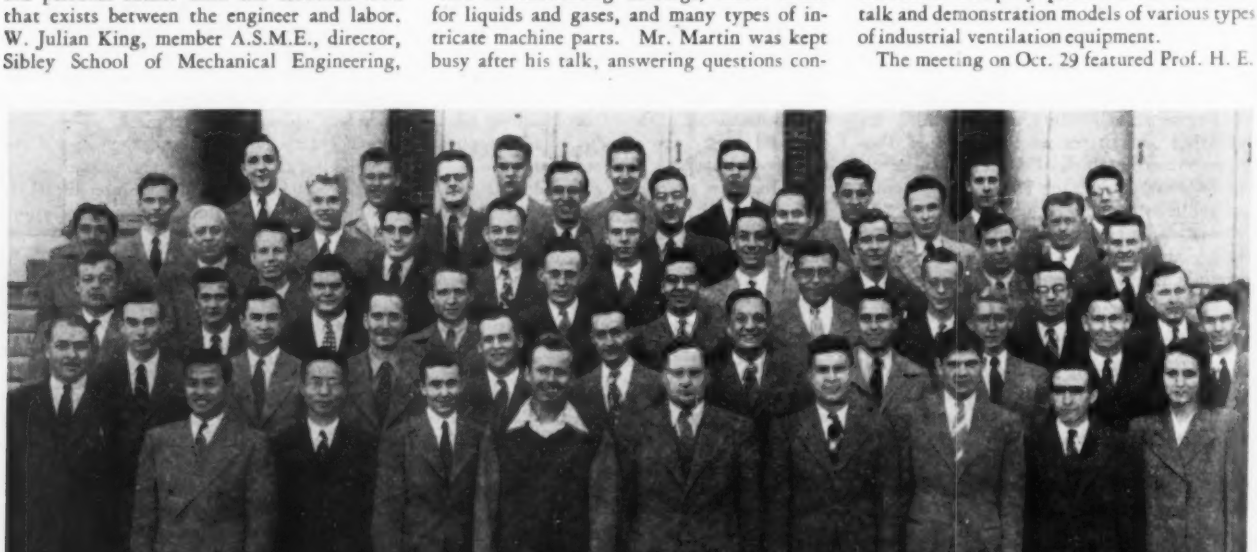
Chairman John Carpenter presided at the Nov. 8 meeting, at which 19 members were present. It was moved that a night meeting be held every week so that many freshmen, sophomores, and junior engineering students could attend who were unable to come to the regular seminar meetings. It was decided that the University would seek the co-operation of the various industries throughout the state in sponsoring the Engineers Fair set for March 1, 1947. Messrs. Drake, Cox, and Cherner were appointed as a publicity committee to aid in advertising the student meeting. The need for an adequate engineering library and reading room was brought up. Professor Ebaugh said that since the new library addition was now almost completed, this would be a good time to get some action on the matter. Messrs. Loest, Hall, and McKee were appointed as a committee to look into the situation.

University of Illinois Branch

The opening meeting of the semester was held on Oct. 9, at which time Prof. N. A. Parker, member A.S.M.E., head of the department of mechanical engineering, spoke on the "Aims and Purposes of the Student Branch of the Society." Officers were elected, and new members were signed up.

On Oct. 16 representatives of the H. H. Robertson Company presented an illustrated talk and demonstration models of various types of industrial ventilation equipment.

The meeting on Oct. 29 featured Prof. H. E.



A.S.M.E. STUDENT BRANCH OF THE UNIVERSITY OF ILLINOIS

Babbitt, who spoke on "The Illinois Professional Engineering Act." The large audience was evidence of keen student interest in the subject.

University of Iowa Branch

On Oct. 23 a meeting was held in the Engineering Building, and called to order by L. E. Fuller, president, who gave a talk on the Ram Jet engine. Mr. Meyer followed with a talk on "The X-Ray Equipment at the Iowa Ordnance Plant at Des Moines, Iowa." Seventy-one were present.

The Oct. 30 meeting was devoted principally to an interesting talk on the aerojet rocket by Mr. Barry. A discussion period followed. Again, 71 were present.

Seventy-five members attended the meeting on Nov. 6, to hear an interesting talk entitled "Powdered Metal" by Mr. Bloethe, and a second interesting paper on the "Helicopter" by Mr. Beckwith. Mr. Croft made several comments on the jet propulsion of propellers which he worked on in 1940.

The meeting on Nov. 13, with 71 members present, presented an interesting talk on "Nuclear Engineering" by Mr. Bowman, and a talk on "Lost-Wax Investment Casting" by Mr. Bruce.

On Nov. 20 the students were entertained with two movies.

University of Kentucky Branch

On Nov. 22 in the study hall, Engineering College, Prof. A. J. Meyers of the Aeronautical Research Laboratory of the University, spoke on airplane engines, particularly the five new types which have been developed during the war. He explained the principles of each of these new types and discussed briefly the characteristics. Professor Meyers then showed a series of charts giving a graphical comparison of performance characteristics for the conventional piston engine, the turbojet, the ram jet, and the rocket, all data being based on the latest stages of development of these engines. No type could be called the best he said, because each had its own particular advantages. He also discussed the difficulties encountered at sonic and supersonic speeds. He closed his talk by stating that it is not wise to be influenced by the extravagant and sensational statements made in newspapers regarding plane speeds.

Marquette University Branch

The meeting on Nov. 14 was called to order by William Pautke, president of the branch, who announced that election of officers for the coming quarter would take place at the next meeting. The speaker of the evening, Mr. Horst, sales department, Murphy Diesel Company, Milwaukee, Wis., was introduced, and gave a very interesting talk on the history, operation, and maintenance of their Diesel engines. A general discussion was held at the conclusion of the talk. Thirty-two were present.

A short business meeting for the purpose of electing officers was held on Nov. 27 in the Engineering Building. The following were elected: George Elwers, president; Les Randall, vice-president; Don Lepsch, secretary; Bill Laidig, treasurer.

Massachusetts Institute of Technology Branch

The Nov. 6 meeting in Huntington Hall was called to order by R. F. Miaskiewicz, chairman, who gave a synopsis of coming programs. The feature of the evening was a film made by the Bethlehem Steel Company entitled "Building the Golden Gate Bridge," which showed the complete fabrication of that suspension bridge. The assembling of panels, transoms, stringers, chests, girders, suspension towers, cables, cranes, and other hoisting mechanisms used, the leveling of the piers on which the towers were erected, and many other features were shown. The photography was excellent and the running commentary was surprisingly lacking in the amount of trade propaganda, so that the audience expressed their approval with warmth.

Soli Dadabhoy Dubash was chairman of the Nov. 27 meeting which consisted of a talk by Prof. Edward R. Schwarz, mechanical-engineering department, textiles division, on the history of textiles and the technological advances made from the beginning of history to the present-day methods for the manufacture of woven, spun, knitted, and felt cloths, ending with the entry of textiles into the plastics industry, and what the future line of research and manufacture of textiles would be. The ground covered in the speech was tremendous, but exceedingly interesting because of the very informal and amusing way that Professor Schwarz treated his subject. During the talk pictures were shown of various laboratory instruments used in the Samuel Slater Memorial Laboratory of the Institute. After the program, the members inspected pictures of various machines in present-day use in manufacture and research, and also some pictures of plastic-bonded fabrics now in use, and some slated for future needs of the industry.

Michigan State College Branch

On Nov. 19 the members made a tour through the Oldsmobile plant of the General Motors Corporation at East Lansing, Mich. The trip through the plant covered the final assembly only but a great deal was learned of the production method of making automobiles. Thirty-eight students made the tour.

Michigan College of Mining and Technology Branch

A meeting was held on Nov. 12 in the campus clubhouse. Prof. A. P. Young, member A.S.M.E., congratulated the membership committee who have 90 paid-up members. This is the largest the branch has ever had. Professor Wittig gave an interesting talk on the benefits of the A.S.M.E., telling of the advantages for both the student and active members; he also told some of his many interesting experiences in industry, and the problems a young engineer encounters.

Mississippi State College Branch

J. O. Stephens, chairman, opened the Oct. 30 meeting in room 106, Engineering Building. He introduced H. E. Wardlaw, senior in mechanical engineering, who gave a talk on the arrangement and function of the repair shops for the Illinos Central Railroad located at McComb, Miss.

University of Missouri Branch

The first meeting of the winter term was held on Oct. 28 in the Engineering Building, and called to order by Ed Sweeney, president. Prof. Paul Ogden, member A.S.M.E., assistant professor, mechanical-engineering department, and Prof. R. L. Scorak, member A.S.M.E., head of the mechanical-engineering department, gave brief talks on the merits of joining the A.S.M.E. while students. Membership cards were distributed. A program of movies followed, showing the Diesel engine and the by-products of ocean water.

Montana State College Branch

On Nov. 4 the branch met in room 218, Roberts Hall, to hear a talk by Prof. Chester A. Arents, member A.S.M.E., of the mechanical-engineering department, on the subject of "Nuclear Energy and Its Application to the Field of Mechanical Engineering." Professor Arents later led a discussion session.

An inspection trip was made on Nov. 6 through the Trident Cement Plant at Trident, Mont., arranged for by George Oiye, vice-chairman of the branch, and Professor Arents, honorary chairman. The tour started at the quarry where the rock is blasted from the side of the hill. From the quarry, the rock was followed to the plant, through the hammer mills, mixing machines, driers, grinders, kilns, and finally through the sacking process. Many machines and their application in the industry were observed. The problems of lubrication in this type of industry were forcibly brought to the attention of the group through the dust in the air.

University of Nebraska Branch

The second meeting of the current semester was held on Oct. 30 in Richards' Laboratory. The newly elected officers presided. Chairman Foster announced the following committee chairmen: Publicity, student White; membership, student Barbur; program, student Crandell; and inspection trips, student Keith Newhouse. Messrs. Wolford and Kell were elected to serve as chairman and vice-chairman of Engineer's Week for the mechanical-engineering department, an annual event being revived for the first time since 1942. Fifty members were present, and 16 new members were received in an initiation ceremony.

On Nov. 20 in Richards Laboratory a joint meeting of the branch with the Nebraska Section was held. Representing the Section were Messrs. Gerald Bachman, C. F. Moulton, George Rogers, and Prof. John Kurtz of the University of Omaha, who spoke briefly. After a short business session, during which Mr. Coale was elected vice-chairman to replace Mr. Gatch, Mr. Rossi presented an interesting student paper entitled "Pipe Bends and Flexibility in High-Temperature Piping." A discussion followed the reading of this paper. Professor Luebs of the University of Nebraska's mechanical-engineering department, gave a colorful account of his service in Europe with the I. & E. Branch. He was a member of the faculty of Biarritz American University. His travels were described with the aid of slides and colored movie film.

University of Nevada Branch

At the first meeting of the new school year on Oct. 16, new officers were elected, and a general discussion of the purposes and aims of the branches conducted by the honorary chairman. Twenty-two of the freshman class of mechanical-engineering students joined. Wallace Birdsall received the well-earned "Certificate of Meritorious Service" for his outstanding work during the previous school year.

University of New Mexico Branch

On Nov. 14 at Hadley Hall a film was presented entitled "Steel for War—Steel Treating and Testing." Hugh Munn, vice-president, Albuquerque Lumber Company, and graduate of the University of New Mexico in mechanical engineering, gave a talk on the opportunities in mechanical engineering. He listed them as: (1) Teaching profession; (2) job with great company; (3) administrative jobs, such as his own. He said that the study of engineering gives the individual a way of life, an interpretation of problems and people entirely different from that given by other training; it teaches recognition of truth and facts, and also gives the experience needed to spend a company's money on equipment. Mr. Munn said that the teaching and study of accounting and economics was important for preparation for administrative jobs, and also the development of one's imagination.

The new officers for this semester are: Brenton Smith, president; Earl Crist, vice-president; Jeannie Harris, secretary-treasurer.

New Mexico State College of A.&M. Arts Branch

At the Oct. 24 meeting those elected for the coming semester were: Lawrence Emerson, president; Clint McClure, vice-president, and Ralph Steinmann, secretary. Mr. Lukens, faculty adviser, told of the advantages of becoming a member of the student branch of A.S.M.E. A committee headed by the vice-president was organized to increase membership in the branch. It was decided that the president represent the A.S.M.E. on the Engineer Council of the school, and appoint his own assistants.

The Nov. 7 meeting in the Engineering Building was presided over by Clinton McClure, vice-president. Ed Walsh and Pete Herlin gave a report on their visit to the exhibition in El Paso, Texas, sponsored by the Southern Union Gas Company. A sound film "Turning Point," produced by the Anti-Friction Bearing Manufacturers' Association, was shown.

North Carolina State College Branch

On November 15 a joint meeting was held with the Duke University branch and the A.S.M.E. Raleigh Section on the campus of the College. The story of this meeting is covered under the Raleigh Section.

University of North Dakota Branch

On Nov. 12 in room 103, Chandler, two movies were shown, both on welding, lent by the Lincoln Arc Welding Company, which were educational and interesting. Plans were discussed for the stag banquet early next year, which is a traditional affair at the University, sponsored by the several student engineering societies on the campus.

North Dakota Agricultural College Branch

On Oct. 23 in the Engineering Building, the following officers were elected for the school term: Edgar Peterson, chairman; Charles Winn, vice-chairman; Wallace Erickson, secretary-treasurer. Harold Zumpf, Richard Gabe, and Merle Hatfield volunteered for the membership drive and program committee. It was decided to start an engineer's club for all engineers.

The meeting on Oct. 31 was called to order by the new chairman, Edgar Peterson. Dr. Posin gave an interesting talk to the 18 members and 50 visitors present.

Oklahoma University Branch

The first meeting of the season was held on Oct. 11 in the Engineering auditorium. Chairman Otto Doner presided. Branch officers and faculty members were introduced. The honorary chairman, Prof. E. F. Dawson, member A.S.M.E., discussed the benefits that a student receives by active participation in branch activities, with special mention made of the competitive awards and the Spring district meeting. Prof. W. H. Carson, member A.S.M.E., dean of the college of engineering, who was to give a talk, was called out of town, and his place was taken by Professor Dawson whose subject was "Insulation Types and Economy." There were 60 present.

University of Pennsylvania Branch

Following a dinner on Nov. 7 in Houston Hall, the first meeting of the branch was called to order by the presiding chairman, Carl Newman, who announced the monthly meeting of the junior chapter, the topic of which was "Combustion Control." Mr. Frank Piasicki, president of the Piasicki Helicopter Corporation of Sharon Hill, Pa., spoke on "Helicopters." He discussed the different subjects of power-plant design, structural design, and the combating of many individual problems peculiar to this highly complex machine. The talk was illustrated by slides and moving pictures of different types of helicopters under present construction, including Mr. Piasicki's own ten-passenger PV-3 model. Mr. Piasicki was a former Towne School student, who completed his schooling at New York University. While there, he constructed one of the first successful helicopters, some parts of which were machined in the University of Pennsylvania's own school shop. A general discussion followed. Forty were present.

Rice Institute Branch

The meeting on Oct. 29 featured E. M. Weiss of the General Electric Company, who gave an interesting talk on "The Selection and Development for Engineering Leadership." The speaker accompanied his talk with lantern slides illustrating some typical employment blanks. Mr. Weiss explained the method by which most employers graded their employees; listed the requirements of a good engineer, executive, and manager; and discussed the ideals which the engineer must uphold. An open forum was held after the talk, with interest centering on the future of the present graduating engineer who is about to enter industry. Forty-two members were present.

University of Rochester Branch

The first regular meeting was held on Nov. 7. Mr. Stacy, a member of the A.S.M.E., Rochester Section, gave a short talk in which he welcomed the new members and answered questions concerning the Rochester Section. He invited the members of the branch to attend a downtown meeting on Dec. 12 to hear a lecture by Mr. Aikens. Chairman John R. Mount invited the members to prepare papers for presentation at meetings.

South Dakota State College Branch

At the Nov. 7 meeting in the Engineering Building, Ralph Peterson, publicity committee chairman, led a discussion on "Improved Methods of Advertising Meetings." It was decided to advertise the meeting through personal contacts, especially by announcements in the classrooms. Robert Nelsen was elected chairman of the Inspection Trips Committee. James Grommersch gave a financial report on the A.S.M.E. Hobo Day activities. The A.S.M.E. float was awarded second prize in the best-stunt division. Robert Nelsen has been named general chairman of the spring banquet committee, by the Student Engineers Council.

Stanford University Branch

A brief meeting was held on Oct. 17 in the Engineering Building, for the purpose of organizing the branch for the new year, and to elect a new treasurer to replace Mr. Golden who is no longer attending Stanford. The new treasurer elected is Mr. Worcester. Mr. Sampson reported on the completion of the class plate for the class of 1946; he made several recommendations to the members on procedure in casting the plates for the wartime classes which were unable to obtain bronze.

A short business meeting was held on Nov. 7, followed by a talk by Prof G. L. S. Jacobsen, member A.S.M.E., on the analyses and cures tried for the complex vibration problems confronting the Navy during the war. The principles which he expressed vividly are of general application in much mechanical-engineering work, and the audience present benefited greatly from this vicarious experience.

Stevens Institute of Technology Branch

Officers of the branch for the fall term are: William Ellison, chairman; Robert Shannon, vice-chairman; Joseph DeFelice, recording secretary; Charles Gehrie, corresponding secretary; and Frank Ross, treasurer.

On Oct. 18 the members inspected the Harrison plant of the Worthington Pump and Machinery Company, where they saw the iron and copper foundry, the welding shop, machine shop, and stockroom. The pattern shop, which is reputedly the largest in the world, was also inspected.

A tour of the Walter Kidde plant in Belleville, N. J., was made on Nov. 5. The students saw the many types of fire-extinguishing equipment manufactured, and the making of

the steel cylinder for holding various gases under pressure was seen in its entirety.

An all-day inspection tour was made on Nov. 18 to the Kearny plant of the Western Electric Company. The students were accompanied by Prof. K. J. Moser, member A.S.M.E., Prof. E. H. Fezandié, member A.S.M.E., and Harold F. Fee, member A.S.M.E., secretary of the alumni association. At the plant they learned about the general production and assembly of switchboard equipment, the processing of quartz crystals for filters and oscillators, and the manufacture of condensers. The various testing laboratories were also visited. Later, the production of coaxial and general transmission cables was examined from start to finish.

On Nov. 22, Ira T. Hook, member A.S.M.E., a research engineer of 25 years' experience with the American Brass Company, subsidiary of the Anaconda Copper Company, spoke on the applications of brass, bronze, and copper in industry. Mr. Hook described the different properties of the various brasses and bronzes which make them useful and sometimes indispensable for certain industrial purposes. He brought with him from his office in Ansonia, Conn., a film entitled "Open-Pit Copper Mining in Chile." This educational color film showed the mining, crushing, leaching, electrolytic refining, and casting processes employed in obtaining copper from the Chuquicamata Copper Mine in Chile, the world's largest known deposit of copper ore. The present plant can produce one and one-half million pounds of refined copper daily. A guest at the meeting was Stanislau Skowronski, an authority in the field of metals, and a member of the American Society for Metals.

University of Tennessee Branch

The meeting on Nov. 7 was held in Estabrook Hall, and called to order by chairman J. C. Maxwell. In the business session Howard R. Wynn was elected as an additional Ace Board representative to fill the vacancy caused by the election of R. H. Grass as Board secretary. The program committee for the December 5 meeting is: R. C. O'Brien, chairman; R. P. Isabell, and H. R. Wynn. Sherman Hixson, program chairman, gave a short talk about the films that were shown for the program. The first movie was "Building Boilers for Ships," presented by Combustion Engineering, Inc. The various processes carried out in the building of boilers were shown in technicolor and explained in a clear and interesting manner. The processes shown are performed at the main plant in Chattanooga, Tenn. The second was on the bellows sylphon made by the Fulton Sylphon Company, Knoxville, Tenn. The Fulton Company is one of the largest producers of temperature-control apparatus in the country. These films are recommended for other branches.

A. & M. College of Texas Branch

On Nov. 5 the first of the regular bimonthly meetings was held in the mechanical-engineering lecture room of Fermier Hall. Chairman R. F. Eisenhauer called the meeting to order, and W. J. Graff, C. C. Crittenden, and W. J. Monas were appointed to represent the A.S.M.E. on the committee for annual engineer's day. The membership committee reported 275 members. A movie was then shown on the Tacoma Bridge disaster. L. P. Thompson, of the mechanical-engineering department, gave a short and interesting talk on vibrations.

The next meeting was held Nov. 19. Ten members were appointed to assist the program chairman with each future meeting. Charlie Slover was appointed to make plans and arrangements for a proposed inspection trip to Dallas and vicinity. E. C. Brown is to plan a similar trip to Houston.

Tufts College Branch

The third meeting of the branch was called to order by James McNeil, chairman, on Nov. 26, in Robinson Hall. George A. Orrok, Jr., member A.S.M.E., of the Boston Edison Company, gave a talk on "Modern Trends in Power-Plant Design." The new Mystic Station was used to illustrate the most modern type station, but Mr. Orrok discussed plans for a new station to be built soon, with even higher pressures and temperatures. He drew a curve showing the savings effected against the cost of installation for different steam conditions. A question period followed, in which Mr. Orrok discussed the hydrogen-filled generator, the reheat cycle, and other topics of interest.

University of Vermont Branch

A business meeting was held in the Waterman Building on Oct. 30. Chairman George Ruble opened the meeting and introduced the first speaker, Mr. Potter, who addressed the group concerning the organization and activities of the former U.V.M. Branch. The chairman then presented a tentative plan of organization and activities for the group to discuss. Bob Curtiss, the second speaker, told of the A.S.M.E. student convention he attended in 1943. Prof. R. G. Chapman, member A.S.M.E., chairman of the mechanical-engineering department of the University, was elected honorary chairman. Eighteen were present.

On Nov. 21 a social meeting was held in the Waterman Building. Eleven members, 9 guests, and the honorary chairman attended the meeting. A movie was shown entitled "Winter Wonderland." Following this, Marion Nelson, treasurer, distributed pins and A.S.M.E. magazines to the members. The publicity committee was appointed, consisting of A. Mongeon, D. Steenburn, C. Spear, and W. Dorr. On the technical committee are J. Durfee, M. Paulson, Leavitt, and Sprague. Calvin Tooles, member of the faculty and amateur magician, gave a magician's show.

Virginia Polytechnic Institute Branch

The Nov. 4 meeting featured a film entitled "Know Your Money." There was an attendance of 107, with Otis M. Glass presiding.

On Nov. 11 two films were shown: The first, "Fluid Drive," produced by the Dodge Division of the Chrysler Corporation; the second, "Automotive Lubrication," produced by the Standard Oil Company. There were 180 present.

On Nov. 18 E. E. Williams, vice-president, A.S.M.E. Region IV, gave a talk on the activities of the A.S.M.E. in the South. Mr. Williams also discussed some of the features of the joint A.S.M.E. and student branch annual meeting to be held in Atlanta, Ga., next spring. With Mr. Williams was Arthur Roberts, Jr., member A.S.M.E., regional secretary, Region IV, who gave a short talk on the good associations developed between members of the A.S.M.E. The audience of 115 enjoyed hearing these representatives of the Society.

Washington State College Branch

A joint meeting with the student chapter of the Society of Automotive Engineers was held on Nov. 18 in room 110, Mechanical Arts Building. Mr. Anderson, chief engineer for Atlas Imperial Diesel Engine Company, Oakland, Calif., gave a talk on "Development, Applications, and Limitations of the Diesel Engine." He discussed early development and more recent improvements of the Diesel engine, and showed slides.

University of Wyoming Branch

New officers were elected at the Oct. 23 meeting in Engineering Hall, as follows: Bob Gose, chairman; Tony Yugovich, vice-chairman; Van Oosten, secretary-treasurer. Tony Yugovich was also elected as chairman of the membership committee. V. A. Frobal was appointed chairman of committee to arrange for the mechanical-engineering booth.

A.S.M.E. Sections

Coming Meetings

Akron-Canton: January 9. Meeting will be held at 6:30 p.m. Subject: "Jet Propulsion and Bell Helicopter," Charles L. Fay, director of flight research, Bell Aircraft Corporation.

Central Pennsylvania: January 9. 110 Home Economics Building, State College, Pa. at 7:30 p.m. Subject: "Whither Engineering," by C. E. Davies, secretary A.S.M.E.

Dayton: January 22. Engineers Club of Dayton at 8:00 p.m. Subject: "Steam-Jet Refrigeration," by an outstanding speaker from Ingersoll-Rand Company.

Fairfield County: January 27. Joint Meeting with the Society for Advancement of Management. Mr. Joseph Manuele of the Westinghouse Corporation will speak.

Kansas City: January 15. University Club, Kansas City, Mo., at 6:30 p.m. Subject: "Physical Testing Up-to-Date and Simplified," by Francis G. Tatnall, manager of testing research, Baldwin Locomotive Works.

Metropolitan Section: N. J. Division. January 2, 7:45 p.m. Essex House, Newark, N. J. "Manufacture of Modern Lubricating Oils."

Management Division. January 9. 7:30 p.m., Room 502.[1] "Factory Organization."

Woman's Auxiliary. January 9. 2:00 p.m. Engineering Woman's Club, 2 Fifth Ave., New York, N. Y. Tea and Musicale.

[1] Engineering Societies Building 29 West 39th St., New York, N. Y.

Materials Handling. January 14. 7:30 p.m., Room 501.[1] "Vertical Transportation in Factories, Warehouses, and Public Buildings."

Industrial Instruments & Regulators. January 17. 7:30 p.m. Room 501A.[1]

Steam Power. January 20. 7:30 p.m., Room 502.[1]

General Meeting. January 21. 7:30 p.m., Room 501A.[1] "Color, Facts, and Fantasies." The ladies are invited.

Forum. January 30. 7:30 p.m., Room 1105.[1]

New Haven: January 8. Ladies' Night Program (Subject to be announced).

New London: January 15. Mohican Hotel, New London, Conn., at 8:00 p.m. Subject: "Three-Dimensional Photography," by F. A. Ramsdell, general manager, Worcester Film Corporation.

Raleigh: January 25. Sir Walter Hotel, Raleigh, N. C. This meeting will be held jointly with the North Carolina Society of Engineers. Subject: "Engineering Development of Automatic Machines for Making New Frozen-Food Containers," by J. W. May, chief engineer, Wright Automatic Tool Company.

San Francisco: January 24. Commerce High School, Van Ness & Hayes Streets at 8:00 p.m. Joint Meeting of Society Member Organizations, San Francisco Engineers' Council. Subject: "Atomic Energy for Power Generation," by Charles Patric Cabell, engineer on Hanford Project, General Electric Company.

Washington, D. C.: January 9. Potomac Electric Power Company Auditorium, 10th, and E Sts., N. W., Washington, D. C. Subject: "The Engineer in Civic Affairs," by Frank C. Hanrahan, county manager, Arlington County, Va.

Waterbury: January 16. University Club, Hotel Elton, Waterbury, Conn., at 6:45 p.m. Subject: "Postwar Patterns and Problems of Materials Transportation," by Charles J. Fagg, president, Newark Central Warehouse Company, and director, Traffic Institute, New York, N. Y.

Western Washington: January 8. Engineers Club, 3rd and Cherry, Seattle, Wash., at 6:30 p.m. Subject: "Design and Development of Marine Cycloidal Propellers," by Thor Henrickson, charge of research and development, Pacific Car and Foundry Company, Renton, Wash.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to members and is operated on a co-operative, nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available to members of the co-operating societies at a subscription of $3 per quarter or $10 per annum, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	212 West Wacker Drive	109 Farnsworth Ave.	57 Post Street

MEN AVAILABLE[1]

PRODUCTION ENGINEER, M.E., P.E.; thoroughly familiar with all phases of sheet-metal fabrication and machine-shop work. Can design tools and dies. Knowledge of electronics. Heavy supervisory experience. Me-131.

MECHANICAL ENGINEER, aeronautical option, graduate; 10 years' diversified experience; machine-tool design; aircraft-propeller-vibration research; officer at Wright Field, Engineering Division, Equipment Laboratory, in supervisory capacity; desires connection in sales or development. Me-132.

GRADUATE B.M.E.: ex-AAF Major; pilot; age 30; 6 years' experience in service maintenance, project development, flight test. Desires engineering pilot or project engineering work. Locate anywhere. Me-133.

JUNIOR ENGINEER, B.M.E. Cornell; age 23; naval engineering officer two years. Desires aircraft research or I.C. engine development but interested any position with real future. California, Florida preferred but not essential. Me-124.

MECHANICAL ENGINEER; 25, single; B.M.E. 1943; Capt. AAF; 2½ years' supervision aircraft maintenance. No civilian experience. Interested in plant maintenance or operation. East preferred. Immediately available. Me-135.

MECHANICAL ENGINEER, D.Sc. degree; 30, married; several years' experience in industrial research; desires responsible position doing research in field of applied mechanics or applied physics. Location, East, Midwest. Me-136.

MECHANICAL ENGINEER, heat-power major; 26; single; 4 years' military experience utilities and machine-shop operation; design, development, testing in aircraft field; one year civilian experience in industrial instruments. Desires position design, development, or operation in thermodynamics field. Me-137.

MECHANICAL ENGINEER, junior, B.M.E. degree from Pratt Institute; 33, single; two years' industrial experience in production department of a ball-bearing plant—costs, controls, layouts, processes, and methods. Desires work of similar nature or some allied field. Good knowledge of statistical methods and able analyst. Prefers New York metropolitan area. Me-138.

MECHANICAL ENGINEER, B.S.M.E.; 18 months' floating-plant maintenance and operation experience; 5 years U. S. Army service. Desires position as assistant plant engineer or other junior engineering position. Me-139-3347-Chicago.

ENGINEERING EXECUTIVE; graduate engineer, class 1913; past positions, chief engineer to vice-president. Experienced designer hydraulic presses, plastic molding, die casting, automotive screw machines, all types machine tools, heavy ordnance equipment. Me-140.

GRADUATE MECHANICAL ENGINEER; age 31; 10 years' varied experience with manufacturer of pneumatic temperature-control equipment; desires design, development, experimental, or research work with manufacturer or consultant in Chicago area. Me-141.

POSITIONS AVAILABLE

PATENT ATTORNEY with at least 5 years' experience in electromechanical instrument or apparatus field; for manufacturer of office equipment. $3500–$4500 year. Brooklyn, N. Y. W-8128.

FACTORY SUPERINTENDENT thoroughly familiar with finest quality cabinetmaking, factory supervision, and all phases of factory maintenance. Salary good, plus bonus. Good opportunity. Upstate New York. W-8143.

MECHANICAL ENGINEER, 35–45, with several years' experience in public-utility work, particularly with piping on high temperature and high pressure, and in addition some turbine work. $4800–$5400 year. Ohio. W-8157CD.

WORKS MANAGER, 40–48, mechanical graduate, with experience in heavy-machine manufacture, precision machine-tool uses and adaptability, including purchases of such tools for specific as well as general usage. Must have proved executive and administrative ability including knowledge of personnel administration, cost analysis and controls, production standards, etc., for manufacturer of heavy container equipment. Salary open. California. W-1865S.

MECHANICAL ENGINEER for design of refrigeration equipment and fixtures. Someone with heat-transfer experience and ability to style fixtures. $5000–$7500 year. Pennsylvania. W-8169.

[1] All mem listed hold some form of A.S.M.E. membership.

PLANT ENGINEER, 25–35, preferably mechanical graduate, with several years' experience in plastics and metal-products field, to select and design equipment, lay out and supervise installation of presses, etc. $4000–$5000 year. Connecticut. W-8177.

MECHANICAL ENGINEER or foreman, 40–50, single status, with over 10 years' experience in large chemical plant, to take charge of machinery and equipment, i.e., boilers, generators, compressors, steam distillers, etc., in soda plant. Will look after repairs and operation of this equipment. One- or two-year contract. Salary good plus room and transportation. Write stating salary expected. India. W-8186.

PRODUCTION MANAGER who under the direction of vice-president of manufacturing division will be responsible for manufacture of sheet-metal products in accordance with established schedules, cost, quality, and budget standards. Will also be responsible for formulation of production policies; setting and maintaining production quality and cost standards; personnel matters; preparation of necessary reports and maintenance of adequate records of production, and approve all departmental efficiencies. Upstate New York. W-8198.

TIME-STUDY ENGINEER with about 5 years, experience in time- and motion-study techniques, methods analysis, rate development, and related cost controls. Should have broad knowledge and extensive experience in factory methods and operation, preferably as related to metal-trade industries. $3600–$4200 year. Pennsylvania. W-8199.

ENGINEERS. (*a*) Chief engineer, preferably under 43, to take charge of all phases of engineering in a coal mine. Should have knowledge of mechanical mining methods and projections, cleaning-plant operations, building construction, land surveys, and property title. $5400–$6000 year. (*b*) Superintendent with engineering education and training. Should have knowledge of mechanical mining methods, preferably with Joy loading machine and Goodman shaker conveyers. Some experience in executive capacity desirable. $6000 year. West Virginia. W-8200.

INSTRUCTORS of mechanical engineering, graduates. Duties include lecture, drawing-office work and supervision of students in laboratory; also research work in department. Should have workshop and drawing-office experience. About $3000 year plus cost-of-living allowance. South Africa. W-8206.

PROJECT ENGINEER, 35–45, graduate, with at least 10 years' experience in design and layout of process equipment, to supervise engineering design, scheduling, and contacts with production management, for food-products manufacturer. $7000 year. New York, N. Y. W-8225.

PRODUCTION-CONTROL ENGINEER, mechanical or electrical graduate. Will be responsible for procurement of all items required in production of electromechanical apparatus, co-ordination of this procurement with manufacturing, and the planning of manufacturing methods. Must have experience in this work. Write for company blank. $7000 year. Northern New Jersey. W-8227.

ENGINEERS, young, mechanical graduates, with several years' experience in oil-refinery work or its equivalent, to make calculations, prepare mechanical designs for process units; prepare material requisitions, supervision of draftsmen, etc., in relation to refinery construction and maintenance. Must be able to make own designs and sketches. Must report single status for two years. $4320–$5760 year to start, plus medical attention, reasonable expenses, and transportation. Persian Gulf area. W-8250.

PLANT ENGINEER, mechanical graduate, with at least 5 years' experience in selecting equipment, preparing specifications, and making layouts, to supervise installation of restaurant equipment. $3900–$5200 year. Must be resident of New York, N. Y. W-8268.

SALES ENGINEERS, 2, mechanical graduates, with 10 years' experience. One to contact utilities consulting engineers and industrials in power field; the other to contact and sell industrial controls in the steel industry. $6000 year. Middle West. W-8285.

INSTRUCTORS, graduates, interested in teaching various phases of production management. Must have 5 years' practical industrial experience, preferably in job evaluation, methods analysis and time study, production, or operating control, etc. Write giving details of education and experience. Upstate New York. W-8286.

POWER ENGINEER capable of supervising operation of jute mill. Should have 10 to 15 years' experience and be capable of modernizing and revamping power-distribution system from the central power station to the various mills and living quarters in the mill compound. Must report single status on first contract. About $7000 year. India. W-8287.

ENGINEERS. (*a*) Mechanical engineer experienced in design, layout, specifications, and purchasing of chemical-processing equipment. $4000–$5400 year. (*b*) Instrument application engineer experienced in application of industrial instrumentation to chemical processes of oil refinery. $4000–$6000 year. Illinois. W-8273.

South African Lectureships Available

APPLICATIONS are invited for three lectureships in mechanical engineering at Howard College, Natal University College, Durban, South Africa. Lecturers are required to work under the general direction of the professor and the duties include lectures, drawing-office work, and supervision of students in the laboratories. Lecturers will also be required to carry out research work in the department.

The salary scale is £450 × 25 — £600 and a cost of living allowance.

Candidates should hold a degree and should have workshop and drawing-office experience.

Application with health certificate and three recent testimonials should be sent to the Registrar, Natal University College, Pietermaritzburg, Union of South Africa.

Successful candidates will be required to assume duty on March 1, 1947, or as soon as possible thereafter.

Candidates for Membership and Transfer in the A.S.M.E.

THE application of each of the candidates listed below is to be voted on after Jan. 25, 1947, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Fellow, Member, Associate or Junior

ACKERLY, O. B., JR., Piedmont, Calif.
ALLSPACH, H. E., Dunbar, W. Va. (Rt & T)
ANDERSON, F. E., Charleston, W. Va.
ARIES, ROBERT S., Brooklyn, N. Y.
ARMSTRONG, WARREN P., Mountain Lakes, N. J.
ARTSAY, NICHOLAS C., Valhalla, N. Y. (Rt)
BAER, HERMAN W., New York, N. Y.
BAUER, RALPH CHRISTIAN, JR., Pittsfield, Mass.
BEACH, ROBERT W., Seattle, Wash.
BELANGER, LUCIEN, Outremont, Quebec, Can.
BINGHAM, SIDNEY H., New York, N. Y.
BLACK, ARTHUR W., New York, N. Y.
BOYLE, THOMAS ALLAN, JR., Painesville, Ohio
BROWN, RAYMOND W., New York, N. Y.
BURNHAM, FREDERICK E., Westport, Conn.
BUSH, CHARLES C., Guyton, Ga.
BYERS, JAMES E., Tulsa, Okla.
CATRON, RUSSELL M., Bloomfield, Conn.
CHANMUGUM, O. D., Colombo, Ceylon
CHIEN, T. H., New York, N. Y.
CLARK, BROWNE E., Topeka, Kan.
CONEYBEAR, J. FRANK, Oak Ridge, Tenn.
COOPER, KENNETH, Oak Ridge, Tenn.
COWING, GUY R., Flint, Mich.
CRONES, J. H., Chicago, Ill.
CULBERTSON, GEORGE W., New Rochelle, N. Y.
DARRIN, RALPH M., New York, N. Y.
DAYAL, P. D., Bombay, India
DEES, RUSSELL E., Philadelphia, Pa.
DEFREES, JOSEPH H., Warren, Pa.
DIXON, LOUIS L. (LIEUT.), Aberdeen Proving Grounds, Md.
DONOVAN, HARRY J., Plainfield, N. J.

DUDIS, CHARLES G., Dayton, Ohio
DUNCAN, ROBERT P., Silver Spring, Md.
EDWARDS, FRAZIER M., Raleigh, N. C.
EGGLESTON, J. E., Glendale, Calif.
EKLUND, S. M., Minneapolis, Minn.
ELLENBERGER, F. RICHARD, Schenectady, N. Y.
ERICKSON, LESTER HENRY, Los Angeles, Calif.
FITCH, HOWARD M., Louisville, Ky.
FRAENKEL, STEPHEN J., Chicago, Ill.
FRASER, NORMAN, New York, N. Y.
FULLER, REX LEROY, SR., Venezuela, S.A.
GANAHL, JOSEPH F., Long Beach, Calif.
GERMAIN, GEORGE B., Minneapolis, Minn.
GIERYN, FRED V., Detroit, Mich.
GOETHE, SAM PAUL, Gainesville, Fla.
GONZALEZ, JOSE E., Los Angeles, Calif.
GRAY, ALEXANDER J., Cincinnati, Ohio
GREENHALGH, KENNETH D., Colonie, N. Y.
GRICE, JOHN F., Baltimore, Md.
GRIER, ALBERT O. H., JR., Wilmington, Del.
GRINDLE, AUBREY J., Harvey, Ill., (Rt & T)
HITE, JOSEPH J., St. Paul, Minn. (Rt & T)
HOPKINS, NEIL E., York, Pa.
HOWDEN, JAMES W., New York, N. Y.
HUISINGA, R. F., Chicago, Ill.
HUTCHESON, J. A., Pittsburgh, Pa.
IBSEN, IB, Los Angeles, Calif.
ISENBURG, PAUL H., Terre Haute, Ind.
JOHNSON, CURT I., Vestal, N. Y.
JOHNSTON, JOHN G., Philadelphia, Pa.
JOHNSTON, S. PAUL, New York, N. Y.
JONES, GEORGE F., South Bend, Ind.
KAYE, JOHN, Pasadena, Calif.
KEENAN, GEORGE M., Allentown, Pa. (Rt & T)
KENNEDY, THOMAS A., Atlantic Highlands, N. J.
KENT, OSCAR, Brooklyn, N. Y.
KESTER, C. D., York, Pa.
KING, ELBERT E., Rahway, N. J.
KROPF, VICTOR J., East Pittsburgh, Pa.
KRUG, F., Montreal, Quebec, Can.
KUHN, E. J., Parsons, Kan.
KUMMER, JOHN F., Youngstown, Ohio
LASKY, CALMAN, New York, N. Y.
LEGGETT, C. W., Huntington Park, Calif.
LEVA, PHILLIP GEORGE, Chicago, Ill.
LEWIS, GEORGE D., II, Philadelphia, Pa.
LINDSLEY, CHARLES W., River Edge, N. J. (Rt & T)
LINVILLE, JACK R., Wheeling, W. Va.
LOOS, CARL W., Upper Montclair, N. J.
LUKINS, R. A., Jeannette, Pa.
LUTZ, PAUL R., Yeadon, Pa.
MACLEOD, D. R., Erie, Pa.
MACNIECE, E. H., New Brunswick, N. J. (Rt & T)
MALIN, BENJAMIN S., Providence, R. I.
MALLEY, HENRY A., JR., Kansas City, Kan.
MASLACH, GEORGE, Pleasantville, N. Y.
MASON, A. L., Charleston, W. Va.
MASON, CLESSON E., Waterbury, Conn.
MCBRIDE, A. E., Dixon, Ill.
MCBRIDE, HOWARD F., Newton, Iowa
MENDELL, WILLIAM H., Oak Ridge, Tenn.
MILLER, DAVID C., Boston, Mass.
MOST, AMICUS, New York, N. Y.
MOTT, E. PARKER, Queens Village, N. Y. (Rt)
MUDLE, S. K., Pittsburgh, Pa.
MYERS, JACOB C., JR., Philadelphia, Pa.
NAKASHIMA, CLARENCE, Honolulu, T. H.
NARAYANAMURTI, D., Dehra Dun, India
OCHENDUSZKO, STANISLAW, Gliwice, Poland
PALMER, RICHARD O., Worcester, Mass.
PARRISH, J. RUSSELL, Des Moines, Iowa
PAYNE, PETER B., New York, N. Y.
PAYNE, R. SMITH, Wallingford, Pa.
PELTIER, FREDRIC E., Orange, N. J.
PEREGRINE, E. P., Tynemouth, Northumberland, England
PETERMAN, GEORGE W., Brooklyn, N. Y. (Rt)
POPP, CHARLES, New York, N. Y.
PYOTT, HENRY H., JR., Reading, Pa.
RAY, KELVIN J., New York, N. Y.
RECKNAGEL, PAUL W., Springfield, Ohio
RICHARDS, A. F., Scranton, Pa.
ROBERTS, G. A., New York, N. Y.
ROSENBUSH, FRED M., Syracuse, N. Y.
ROSENTHAL, DANIEL, Los Angeles, Calif.
ROUBLOFF, ALEXANDER D., Buffalo, N. Y.
ROUSE, HUNTER, Iowa City, Iowa
RYNDERS, ARTHUR, Milwaukee, Wis.
SACKS, NEWTON N., Rock Island, Ill.
SARWAR, G., Rawalpindi City, Panjab, India
SCHAEFER, JOHN G., Youngstown, Ohio
SHAND, ERROL B., Corning, N. Y.
SHEDDEN, LOUIS L., Shreveport, La.
SHOHET, NORMAN E., New York, N. Y.
SIDWELL, W. K., Newark, Ohio
SIHLER, FREDERICK C., Denver, Colo.
SOLD, ROBERT F., Elmhurst, N. Y.
SPENCER, DONALD L., Durham, N. C.
SPENCER, HERBERT L., Lewisburg, Pa. (Rt)
SPINNEY, V. L., New York, N. Y.
STEVENSON, ANDREW, Chevy Chase, Md.
STINE, W. VIRGIL, Asbury Park, N. J.
SURYANARAYANAN, C. S., Bangalore, India
SWIFT, JUDSON J., Brooklyn, N. Y.
TAYLOR, RUEL E., JR., Atlanta, Ga.
THUT, WALTER W., New York, N. Y.
URATSU, HIROSHI, New York, N. Y.
VANDEGRIFT, ERSKINE, JR., Birmingham, Ala.
WANNER, RICHARD G., York, Pa.
WARD, ROY EDWIN, Philadelphia, Pa.
WEAVER, HARRY L., Charleston, W. Va.
WEST, ANTON J., Pittsburgh, Pa.
WILSON, VERNON C., Atlanta, Ga.
WINKELMAN, LOUIS A., Newark, N. J.
WISLER, JOHN F., Sturgis, Mich.
WOODROW RICHARD H., Bridgeport, Conn.
WROTEN, JOHN F., JR., Baltimore, Md.
YOST, WILLIAM A., JR., Wauwatosa, Wis.
ZASLER, JACK, Oak Ridge, Tenn.

CHANGE IN GRADING

Transfers to Fellow

DAHLSTRAND, HANS P., Wauwatosa, Wis.
HOLZBAUR, FREDERICK J., Kansas City, Mo.
SPORN, PHILIP, New York, N. Y.

Transfers to Member

ARTHUR, W. E., Los Angeles, Calif.
BLADES, ROGER T., Bartlesville, Okla.
BODGER, W. KENNETH, Jeannette, Pa.
COOPER, KENNETH K., Fort Wayne, Ind.
DAVES, HOWARD W., Alcoa, Tenn.
DONOGHUE, F. FRANCIS, Worcester, Mass.
EDWARDS, GILBERT E., Stoneham, Mass.
FINDLEY, W. N., Urbana, Ill.
FINNERTY, FRANK, New York, N. Y.
FRIDSTEIN, ROBERT B., Chicago, Ill.
GABRIEL, EDWIN Z., Red Bank, N. J.
HENRY, HOWARD J., Franklin, Pa.
HEUSER, HENRY V., Louisville, Ky.
HOLTON, ADOLPHUS, Norwood, Mass.
KENNEDY, WENDELL C., Alcoa, Tenn.
KOP, PETER E., Trenton, N. J.
LEGGETT, JOHN R., Nutley, N. J.
MALEDY, J. E., Taft, Calif.
REDDY, DERMOT, Bridgewater, Va.
RITCHINGS, ROBERT H., New York, N. Y.
SMITH, RANDOLPH M., St. Louis, Mo.
WALKER, A. MARRIOTT, Detroit, Mich.
WYER, RAMON, Canton, Ohio

Transfers from Student Member to Junior 60

Necrology

THE deaths of the following members have recently been reported to headquarters:

JOYCE, CHARLES S., July 5, 1946
MOSS, SANFORD A., November 10, 1946
RICE, ARTHUR L., November 10, 1946
SACHS, JOSEPH, November 15, 1946
SCHOENFELDT, WILLIAM, October 15, 1946
SICKLES, EUGENE C., April 12, 1946

A.S.M.E. Transactions for December, 1946

THE December, 1946, issue of the Transactions of the A.S.M.E., which is the *Journal of Applied Mechanics*, contains:

TECHNICAL PAPERS

Cylindrical Buckling of Sandwich Plates, by J. N. Goodier

General Stress-Strain Laws of Elasticity and Plasticity, by A. Gleyzal

Supersonic Nozzle Design, by A. E. Puckett

Analytical Design of Centrifugal Air Compressors, by C. Concordia and M. F. Dowell

Forced Torsional Vibrations With Damping: An Extension of Holzer's Method, by J. P. Den Hartog and J. P. Li

Orthogonal Functions Used in the Solution of Linear Difference Problems, by S. U. Benscoter

A Note on the Damped Vibration Absorber, by J. E. Brock

An Improved Fuse Escapement for the Mark 18 and Other U. S. Navy Mechanical Fuses, by F. G. Kelly and J. L. Zar

Control and Prediction of Pulsation Frequency in a Duct System, by W. R. Heath and W. R. Elliot

The Theory of Curved Beams, by G. C. Best

DISCUSSION

On previously published papers by M. A. Prohl; George Sachs and J. D. Lubahn; G. J. Schoessow and L. F. Kooistra; E. R. Van Driest; O. R. Wikander; O. J. Horger and W. I. Cantley; and L. R. Koenig

BOOK REVIEWS